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Coal Age

Volume 45 Number 11

Photoelastics sounds far removed from coal mining to most of us. In fact its theory and applicative technique have seemed beyond our grasp. However, Phil Bucky tells us in this issue, p. 54, that breaking props, heaving bottoms and spalling mine pillars may be accurately measured in terms of strain and stress by model experiments. Written in words of few syllables, the article brings to mind many possible solutions for control and maintenance of mine openings in any high-cost operation. . . . **Arc-welded locomotive tires** cut cost in half at 40 per cent of the mines surveyed by Coal Age during the last two years. Opinions of officials vary widely, states Jack Edwards in a forthcoming article, but names, dates and places, with details of individual practices and results, are given for all interested readers. Those not interested in lower maintenance and replacement costs — may skip it. . . . **"As usual"** is a much overworked phrase, and nowadays it rarely applies. Even annual meetings take on the vim and verve re-

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(CONTINUED FROM PAGE 5)

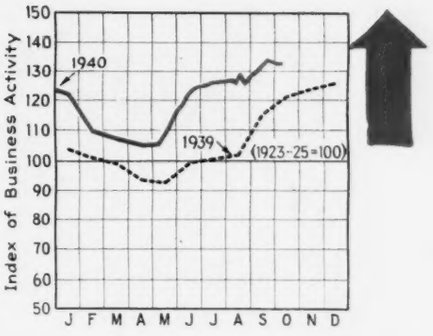
flected from things accomplished in these fast-moving times, and to come. The 29th Annual National Safety Council meeting at Chicago is highlighted in this issue, p. 72, as is the 33d annual meeting of the West Virginia Coal Mining Institute, p. 80. Our editors were in attendance at both meetings, "as usual."

Oil-coal mixtures deserve consideration where liquid fuels are sought at lower prices than fuel oil, writes J. G. Hedrick in an article soon to be published in Coal Age. . . . **Stray currents** in a mine are dangerous. Proper grounding of electrical equipment eliminates this hazard. Methods of testing and finding "sneak" currents are outlined in the article by Paul C. Ziemke, p. 44. Maintenance men will like it, too. . . . **Canadian coal-mining methods** are interesting these days to all of us. Innovations of distinctly American and British devices are being tried out at the Bras d'Or Coal Co., Nova Scotia, and the result of these changes will be told by R. Dawson Hall in an early issue. Time-study performance records are included to show man-minute operating efficiencies under their particular physical conditions. . . . **Front cover space** this month was released for editorial use by Timken Roller Bearing Co., whose advertisement occupied that spot last November.

HOW'S BUSINESS

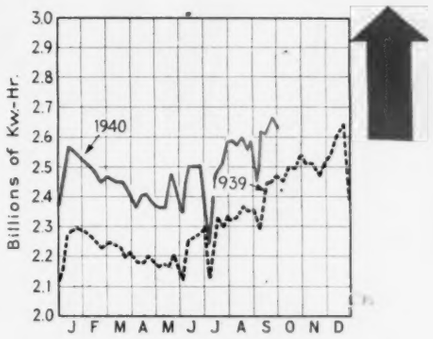
GENERAL BUSINESS CONDITIONS

Business is still in the "unanimous phase," according to *Business Week* of Oct. 12, which notes that during that week the steel rate advanced 1.6 points to 94.2 per cent of capacity, the highest level since the boom of last December. The index on the above date was 132.4, compared with 132.9 the preceding week and 129.2 a month previous. The stock market, however, still lags 40 per cent behind 1937 levels.



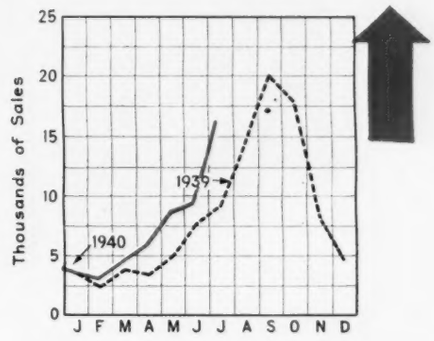
ELECTRICAL POWER OUTPUT

Output of electric energy by the electric light and power industry reached an all-time high during the week ended Sept. 28—2,670,000,000 kw.-hr.—the following week showing a dip to 2,640,949,000 kw.-hr. The latter, however, is 7.1 per cent above the corresponding week of last year. The week ended Sept. 21, the first following our last report, showed production of 2,629,000,000 kw.-hr., a recession of 10,000,000 kw.-hr. from the preceding week.



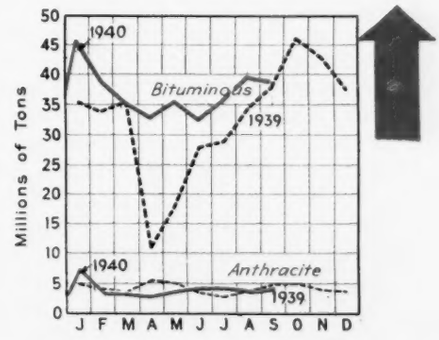
COAL STOKER SALES

Mechanical stoker sales in the United States in July last totaled 16,834 units (U. S. Bureau of the Census from 107 manufacturers), compared with 9,986 in the preceding month and 9,614 in July, 1939. Sales of small units in July last were: Class 1 (under 61 lb. of coal per hour), 15,384 (bituminous, 14,177; anthracite, 1,207); Class 2 (61-100 lb. per hour), 715 (bituminous, 686; anthracite, '29); Class 3 (101-300 lb. per hour), 460.



COAL PRODUCTION

Bituminous coal produced by United States mines in September last (preliminary) totaled 38,413,000 net tons, according to the Bituminous Coal Division, U. S. Department of the Interior, which compares with 39,240,000 tons in the preceding month and 38,465,000 tons in September, 1939. Anthracite tonnage in September last was 4,053,000 (preliminary), according to the U. S. Bureau of Mines, against 3,775,000 (revised) in the preceding month and 4,840,000 tons in September, 1939.



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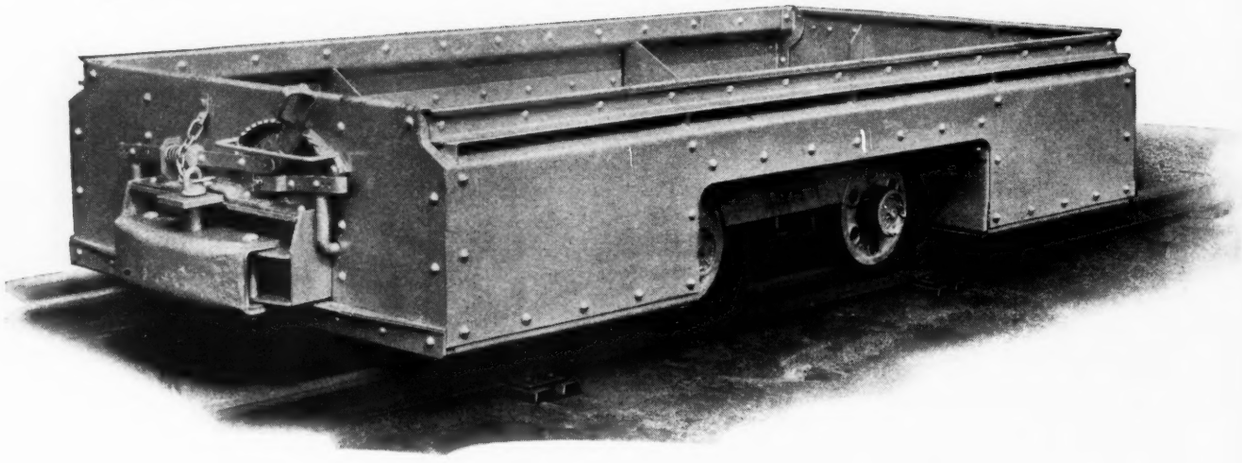

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Coal Age

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SYDNEY A. HALE, Editor • NOVEMBER, 1940

Pertinent and Impertinent

• POLITICAL PROGNOSTICATIONS are outside the modest province of these pages. Two facts of great importance to the coal-mining industry, however, are readily discernible without the aid of crystal balls or ouija boards. Regardless of who wins the elections this month, the national-defense program will both continue and expand. That program inevitably means an increasing demand for fuel for armament-manufacturing plants. No coal producer can afford to lose sight of these two facts in his 1940–41 planning.

• LAST YEAR, for the first time in history, the value of petroleum production in Illinois exceeded that for coal. But it took a fourfold increase over the 1938 oil output of the State to do it. With production from the new Illinois wells already reported as past the peak, however, this primacy promises to be short-lived.

• CANADIAN mine workers in the Western provinces of the Dominion some months ago entered into a wage agreement with Alberta and British Columbia operators to run until one year after the end of the war. Under this contract with District 18 of the United Mine Workers, whenever living costs increase 5 per cent above the 1938 base, a bonus equal to that increase will be paid all workers. Living costs are reviewed by a commission every four months. The mine workers themselves stipulated that increased taxes due to the war should be excluded from the living-costs computations. So far, no bonus has been authorized. Canada is at war; the United States is engaged in a national-defense program which includes all steps "short of war." Would it be impertinent to commend this Canadian agreement to the gentlemen who will assemble in New York next March to negotiate a new Appalachian wage contract?

• HOW TO SPEND the long winter evenings should be no problem for the coal salesman this year. He has the Guffey minimum-price schedules to while away the postprandial hours. Whether he will find the handiwork of the Bituminous Coal Division of the Interior Department fascinating, terrifying or merely mystifying is a question still unanswered.

• A ROUND-UP on the progress of research made in mid-September shows that ten coal associations, three railroads and thirty-three individual coal-mining companies had pledged financial support to the proposed revival of activities by Bituminous Coal Research, Inc. All honor to this valiant forty-six. But where are the other groups and individuals that should be backing this movement? Still hoping to profit from the other fellow's vision and contributions?

• COAL CONSUMERS may be willing —even eager—to pay increased prices for fuel as a contribution to industrial rehabilitation. How else explain that bituminous-coal pro-

duction the first week the minimum-price schedules became effective was 15 per cent less than during the preceding week of unregulated competition?

Alien Registration

A TOTAL of 3,600,000 aliens are now believed to be residing in or visiting the United States. Up to Oct. 12, reports the Director f Registration, 1,903,483, or 53 per cent, had completed the forms required under the Alien Registration Act of 1940. Only 386,941, or approximately 20 per cent, of these registrants were from the six top-ranking coal-producing States, against 1,164,452, or 61 per cent, from all Atlantic and Pacific Coast States exclusive of Pennsylvania. This would seem to indicate that alien concentration in the United States is attributable to other industrial activities than coal mining.

However, the fact also remains that only an estimated total alien population figure is available for the present yardstick and that the actual number is still in question. How many of the actual total are employed in the coal mines of the country, who they are and where they are working should be accurately determined by close cooperation within the industry. The preservation of friendship and loyalty of law-abiding aliens is dependent upon the registration of all of them.

Trial and Error

NO REASONABLE MAN could expect that the first attempt to establish a complete schedule of minimum prices for all bituminous coals would be a jewel without a flaw. The interrelations involved are too many and too complex. Coal operators themselves have been battling over these relationships for generations and have been readjusting them to meet changing conditions. Disagreements have been frequent and bitter. Temporarily freezing such relationships by government fiat does not necessarily eliminate causes of contention. And even this freezing has taken over three years.

Individual producers, districts and consumers already have protested adjustments which they think will affect their particular interests unfairly. More such protests may be anticipated as the schedules meet the test of actual operation. The time, the effort and the money put into their formulation demand that they be given a fair—and critical—trial. Then facts as to their effects can be substituted for opinion and fears. The verdict next spring, however, will depend largely upon how responsive the regulating authorities are to the impact of these facts.

Floods and Roof Falls

DURING a recent Susquehanna River flood, counter-pressure was used by householders to prevent water approaching basement ceilings lifting the building or bursting the floors. This counter-pressure was established by drilling holes in the boards so that the water could well up and fill the room. A somewhat similar condition occurs in a mine which is flooded. So long as the flood water remains in the mine, the upward pressure of the water under the roof balances the downward pressure above it, but after the water is lowered, only the downward pressure remains. This downward pressure continues with gradually decreasing intensity until the water has escaped from the measures.

For safety, therefore, one hole or several should be drilled from the surface or from an unflooded level or seam so that the water can escape by the bedding planes into the hole and thence fall freely into the lower seam. Thus much roof failure will be prevented and the mine will be ready sooner for operation or development. Moreover, time will be saved because the lowering of the water by pumping can be speeded without fear for safety or roof breakage. Less time, too, will be lost in cleaning up falls and removing methane. Even in unflooded mines, such reduction of water pressures may be helpful.

The holes drilled could later be used for bleeding off gas and, in a degree, for ventilation. They also could prevent the air in the mine from belching up the shaft, in much the same manner as gas will escape in a body from a tilted pop bottle. On more than one occasion men working on cages and pontoons in dewatering mines have been thrown into the water and drowned by such belchings of the mine atmosphere. Explosions, too, have occurred when such belched gas was ignited.

Anthracite Allocations

WHILE bituminous operators are entering the shadow of government price control, their anthracite brethren are experiencing difficulties with voluntary allocation. The plan adopted by the hard-coal producers some time ago for controlled output on the basis of estimated demand and past performance is having increasingly tough sledding. Part of the present difficulties are internal; part are external. The internal difficulties are a present actuality; the external, a threat.

Any attempt to allocate tonnage, even though it be to halt a march to bankruptcy over the road of ruinous price competition, must be distasteful to ambitious producers who feel their salesmanship or other advantages would give them a larger share of business in a free market. Even the possibility that a raid on a competitor's customers will invite reprisals and a renewal of price cutting will not always stay such producers. This seems to be the root of the internal difficulties now menacing the anthracite control scheme.

The external threat is the possibility of Federal Government action under the anti-trust statutes. That possibility was pointed out in these pages last March when attention was called to the attitude of the Department of Justice to a curtailment program in the cotton-textile industry. The Sherman law is a cold document which makes no distinctions as to motives or results; any warmth injected into its phrases must come from unpredictable departmental and judicial interpretation. Whether this threat can be turned aside by the proposal of Representative Flannery for a Congressional investigation of the anthracite situation remains to be seen.

CONVEYORS WIN OUT

Over Difficult Natural Conditions

At Beckley Fire Creek's New Penman Mine

By J. H. EDWARDS
Associate Editor, Coal Age

UNDAUNTED by extremely frail and variable roof—a condition unforeseen in opening the Penman mine in coal that was known, however, to be thin and wavy—officials of Beckley Fire Creek Coal Co. are winning a fight which at times threatened to doom to idleness the modern plant completed in December, 1937. Last year Penman shipped 92,484 tons and, despite the natural difficulties, present production of 500 tons per day, much of it from development through thick drawslate, is being achieved at the rate of 3.8 tons per man-shift including the superintendent. After almost 2½ years of work, the main entry has for the last 1,000 ft. penetrated coal running consistently between 29 and 35 in. thick and having the favorable top expected when the mine was planned.

The mine is a 100-per-cent conveyor operation. Shakers and duckbills handle both coal and rock in development of haulage headings. Chain conveyors are used in rooms and for the most part in driving the aircourses. Two mother belts discharge the room coal to steel cars carrying 4 tons. From a rotary dump near the drift portal the coal is conveyed to the tipple, situated at a 600-ft. lower elevation, where it is prepared by shaker and vibrating screens, handpicked and oil-treated.

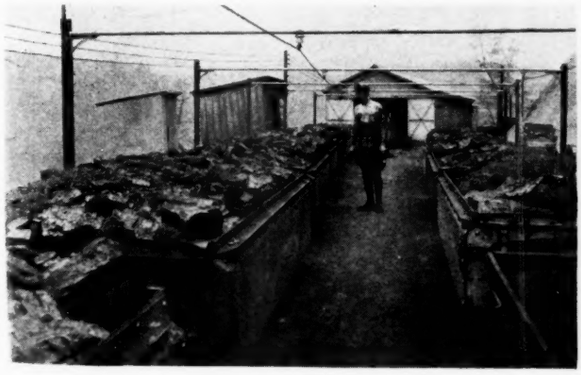
Penman mine is in Raleigh County on Piney River gorge. The tipple is on Piney Branch of the Chesapeake & Ohio Ry. six miles from the main line on New River. The mine office, commissary, new village and headhouse, ten miles from Beckley, are served by a new rock-surfaced road branching from the route that leads to Grand View.

The property, which is held in fee, comprises a 2,000-acre block of Fire Creek seam. Cover ranges up to 500 ft. and outcrop openings can be developed to hold air travel to relatively short paths. In general the seam rises 50 ft. to the mile from the drift portal; thus the over-all track grade favors the loads. Local grades, seldom over 300 ft. long, are frequent, very irregular and reach 13 per cent.

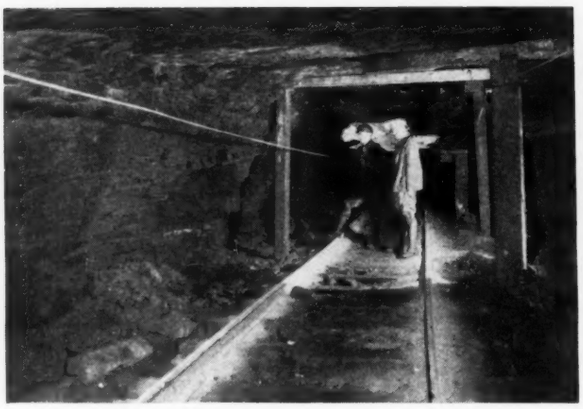
Thus far the coal has averaged 30 in. but the limits encountered are 12 in. and 48 in. In all cases the seam is free of partings. The bottom is very hard. Top over the area already developed turned out to be a weak slate, although drillings had indicated it was the same as in other Fire Creek mines. The drawslate between the coal and the "good Fire Creek roof" ranges from nothing to 8 ft. It is so frail that any brows left hanging where top has been taken on a haulway break loose and fall in a few months.

Because of the wide range of conditions, the work to date has deviated in several places from the mining plan first adopted. A revised projection is now being followed. A change contemplated as standard, because of the grades, is a reduction of length of panel or belt entry from 1,500 to 1,000 ft. Cross entries are to be on 2,000-ft. centers. Rooms are driven 40 ft. wide and 300 ft. deep on 70-ft. centers; the 30-ft. pillars are brought back with their faces at an angle to provide a 40-ft. length.

Instead of a standard centers-dis-



Left—Four-ton conveyor-loaded cars approaching the dump at the headhouse. John Popovitch, outside foreman, pauses beside a well-filled car. Right—Over the hill goes the mine rock.



Left—E. E. Evans and W. B. Crickmer on the main haulway, where the coal is but 22 in. thick and 8 ft. of drawslate had to be taken to bare the "good Fire Creek top." Right—W. B. Crickmer and E. E. Evans at the shaker which drives the main haulway.

tance for posting in rooms, timbers are set as conditions demand, and only a few are recovered. An attempt is made to get 100 per cent of the coal in a panel and as a rule the top in a room falls close behind the pillar face as it is worked back. In many instances the top has proved so difficult that rooms had to be narrowed to 25 ft. and the 45-ft. pillar recovered by pocketing so far as possible.

Four room conveyors discharging onto one mother belt is the normal set-up. Three men work at each room face and are paid day rate. Close supervision is recognized as the principle which must rule in obtaining efficiency in the work. The mine operates three shifts per day five days a week. Each day the tipple is operated only a part of two shifts, because there are not enough mine cars to store the production of a full shift.

Use Double-Entry System

Mine development will be continued on a double-entry system, the haulway 12 ft. wide and the aircourse (no top taken) 18 to 20 ft. wide. On the belt-way of a panel entry a 36- to 42-in. height would be sufficient, but, in much of the work, character of the roof has required taking more than enough to provide that height. Tracked haulways are driven to provide not less than 6 ft. of height from bottom to roof. The main line has 60-lb. track; cross entries, 45-lb., and the electrical continuity of both is provided by arcweld bonds.

Face-preparation equipment consists of seven Jeffrey A-7 hand-held drills and ten Goodman shortwall cutters. Five of the latter are 50-hp. 212AR low-vein, three are 35-hp. 112AR universal and two are the 50-hp. type 112. Cutting is done "right on the bottom" and the coal is shot with duPont Monobel E. Auxiliary ventilation is provided by ten Jeffrey blowers with duPont Ventube. Four blowers are Aerodyne Midgets and six the centrifugal type. Air for rock drilling is supplied by two Ingersoll-Rand air-cooled compressors.

Conveying equipment consists of three Goodman shakers (two 15-hp. and one 12½-hp.) with duckbills, three Goodman 30-ft. chain face conveyors, one Goodman 300-ft. chain room conveyor, two Goodman 26-in.x 1,500-ft. belt conveyors, four Jeffrey 61HG 30-ft. face conveyors, one Jef-

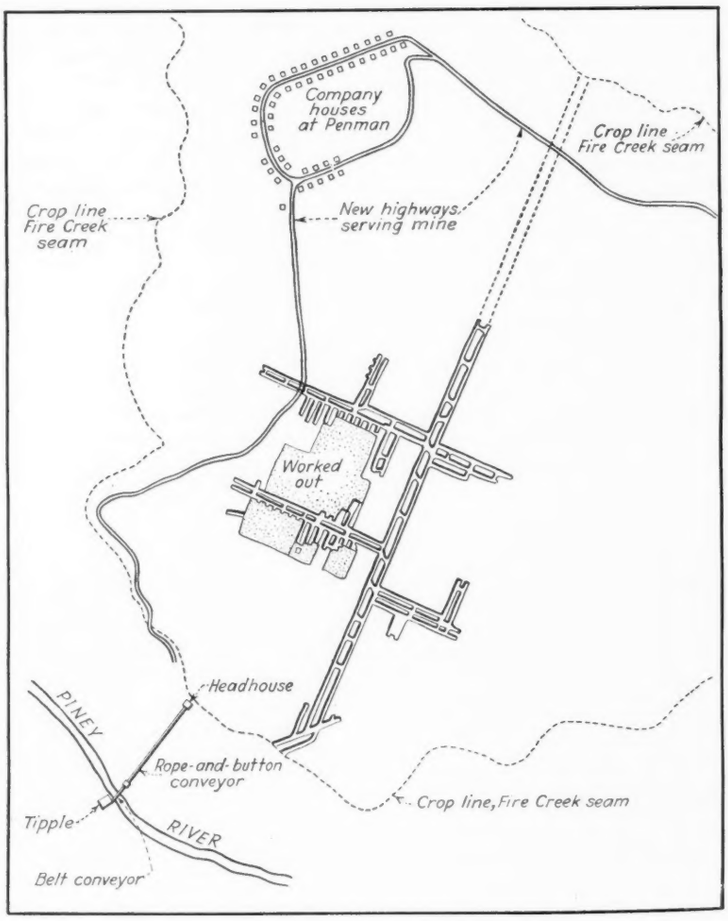
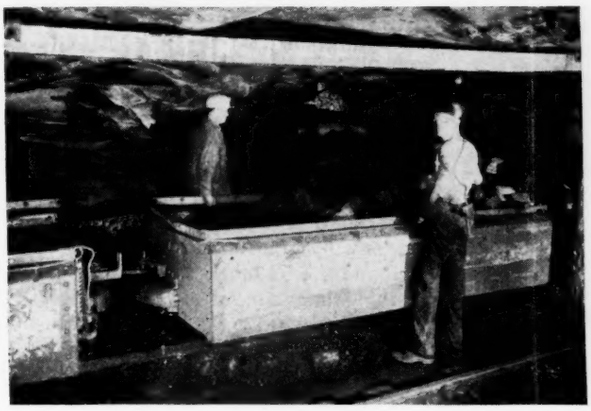
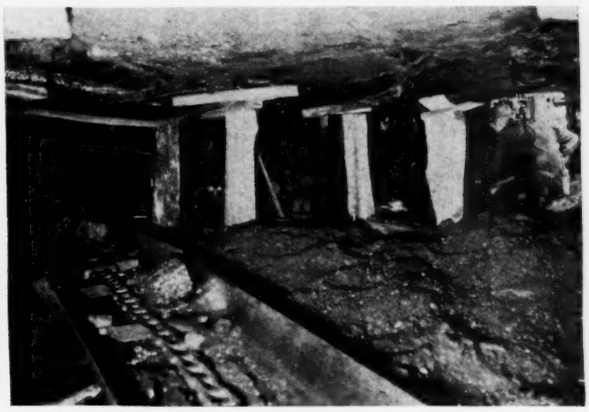


Fig. 1—Mine layout at Penman.





Right—Room and face conveyors in one of the tough rooms where bad top required pocketing recovery of the pillar. Left—On this haulway, where the mother belt discharges, the top of the coal appears between the cars at about knee height.

frey 61EW elevator and eight Jeffrey 61AM 300-ft. room conveyors.

In driving track and belt entries with duckbills, the usual practice is to take the coal for about 200 ft., then drop back and shoot and load the top slate. An optional method of taking one cut of coal and then a "lift" of rock was tried, but progress was slower and difficulty was experienced due to slate breaking loose from the brows and getting into the coal. With three entries under way and only three duckbills, chain conveyors are used in driving the aircourse for each entry.

Seventy new all-steel solid-body Kanawha cars, 4-ton capacity conveyor loaded, handle the haulage. Tare weight of the new car is 4,450 lb. Height above rail is 29 in. and inside dimensions are 6½x12 ft. Track gage is 48 in. and the 14-in. wheels—on stub axles—are equipped with Timken bearings. One end of the car has a spring bumper and drawbar; car fittings include brakes.

Sled Moves Supplies

Four locomotives handle the trips and supplies. One is a Westinghouse 13-ton, one a Westinghouse 6-ton, one a Jeffrey 6-ton, and the fourth a General Electric 6-ton. A material sled (Sept., p. 67) riding only 4 in. above the top of the rail and pulled or pushed by the locomotives is considered an indispensable convenience for carrying conveyor drives, pans, pumps, mining machines and even long heavy timbers for crossbars. Three 50-g.p.m. Foos gathering pumps dewater the dips. Just enough water is encountered in development and rooms to suppress dust. Main ventilation is supplied by a 7-ft. Jeffrey Aerodyne fan driven by a Westinghouse 10-hp. 220-volt a.c. motor.

Headhouse, slate dump, tipple and mountainside conveying system were built by Kanawha Manufacturing Co. Maximum rated capacity is 300 tons per hour. The tipple spans five loading tracks and has four loading booms, three of which are preceded by picking tables. A main shaker 74 in. wide makes lump, egg and stove, and at present the exact sizes are 8-in., 8x3-in. and 3x1¼-in. respectively. One man is employed at the egg table and six at the stove table. The lump coal is so clean that picking is not necessary. Domestic and steam are the markets served.

Coal Oil-Treated

The 1¼x¾-in. coal from the main shaker is separated into 1¼x¾-in. nut and ¾-in. slack by a Nordberg-Symons level screen. Oil-treating equipment includes a 10,000-gal. railway-type storage tank buried in the ground with the top of its dome a few inches below the floor of the pump house. A Brown-Fayro Model 2F8 high-pressure 480-gal.-per-hour oil pump is driven by a Westinghouse Type CS 5-hp. motor. Pigott Model 2F8—a Standard Oil product—is applied as the treatment.

To make room for the tipple and tracks, the bed of Piney Creek was changed to the opposite side of the valley floor. Tipple tracks accommodate 60 empties and 70 loads. The framing of the tipple is heavy sawed timbers; steel was used in building the headhouse and conveyor galleries. All structures are sheathed with corrugated galvanized steel.

The rope-and-button conveyor is 900 ft. long and its slope is 30 deg. From the discharge of this button conveyor the coal is carried overhead across the creek to the tipple by a 42-in. belt 175 ft. long, centers distance. The 1¼-in. rope of the button conveyor is driven through Jeffrey sprockets by a 50-hp. motor normally working regenerative and fitted with a solenoid brake. As a safeguard against failure of the motor or of its V-belt drive connection, a band-type brake, on an intermediate shaft and with hand lever control at the dumper's station, also was installed.

Mine cars are weighed on a Fairbanks-Morse springless scale with Printomatic Weigher. The rotary dump makes a complete revolution for each dump; its motor operates continually and the dump motion is controlled by a hand lever which shifts a countershaft and its friction pulley one direction to engage a driving pulley and the other direction to encounter a brake block. A reciprocating feeder delivers from dump hopper to a chute that loads the button conveyor.

Incline for Materials

Paralleling the conveyor system is a material-handling incline 1,100 ft. long fitted with 40-lb. track and served by a hoist at the top of the hill. Locomotive sand is hauled up over a trestle at the mine track to an elevation where it flows by chute to a bin that tops a sand dryer situated at track level. Slate and mine rock are dumped over the hillside from the solid-body cars by a Kanawha portable dump which in this case is installed as a stationary job 100 ft. outby of the headhouse.

Plant motors are 220-volt a.c. Two are Westinghouse and the rest General Electric. Falk reducers are incorporated in all drives of the slow-moving machinery. Allen-Bradley

Fifty-two single-family houses were built on the plateau at Penman.

starters and Bull Dog safety switches comprise the electrical controls; wiring is in rigid conduit.

Power is purchased and the d.c., the only power used inside, is supplied by one manually controlled 300-kw. G.E. 275-volt rotary converter in an outside substation near the drift mouth. Power factor is corrected with a 60-kva. 4,000-volt Type CH-1 capacitor installed in the substation building. No. 4/0 Fig. 8 trolley wire on the haulway and a 500,000-circ.mil feeder in the aircourse constitute the positive line. Total power used at the operation amounts to 4.8 kw.-hr. per ton and the power cost is 8½c. per ton.

In the vicinity of the mine portal are two other buildings; one is the mine shop and the other houses the mine foreman's office, lamp house and bath house. The latter has 156 baskets and the lamp equipment consists of 156 Edison Type K. Inasmuch as the mine is only 10 miles by highway from Beckley, where machine-shop service and repair parts are available, only a few supply items are kept on hand at the mine and these few are kept in a partitioned corner of the shop. For the same reasons no machine tools have been installed. Recently a new Hobart 300-amp. "Simplified Arc Welder" was purchased, primarily for repairing conveyor pans and adding new ends, cut from $\frac{3}{8}$x2½-in. bar iron, to broken conveyor flights. Cutting-machine bits are sharpened manually and tipped with Stoodite.

Town buildings erected at the mine comprise 54 dwellings and a frame structure housing commissary, office and post office. Two of the houses are "on the bottom" near the tipple and the 52 others are at an excellent building site on the plateau three-quarters of a mile from the pit mouth. All houses are single-family type, frame construction.

Incorporated specifically to open and operate the Penman mine, the Beckley Fire Creek Coal Co. is one of the Laing interests. John Laing, of Charleston, who from 1908 to 1913 was chief mine inspector for West Virginia, is president of this new company and of the MacAlpin, Wyatt and Morrison Coal companies. James Martin is vice-president in charge of operation and D. W. Martin, vice-president in charge of sales. W. B. Crickmer, of MacAlpin, superintends Penman in addition to the MacAlpin mines, where conveyors have been operated with marked success in 32-in. coal of fairly flat lie and favorable top. At Penman mine Ed. E. Evans is mine foreman and John Popovitch outside foreman.

Penman headhouse, rope-and-button conveyor and tipple as viewed from the Stanaford side of Piney River gorge.

ANTHRACITE CLEANED

By Sink-and-Float Methods

At Annex of Locust Coal Co.'s Weston Breaker

Sink-and-float methods are applied at Weston breaker to solve with accuracy the most difficult cleaning—which is to determine the borderline between coal and near-coal — after the broader classification has been made in the main breaker. But it could have been used equally well, it is believed, for the roughing job also. Power costs are low. Degradation is at a minimum and present treatment handles as great a proportion of rejects as does the main breaker.

IN "DYNAMIC SEPARATION," both the substances cleaned and the mediums in which they are cleaned are in motion, and the separation depends on the currents to lift the lighter material and let the heavier material fall. These currents, however, may not be uniform throughout the medium. They have a lifting ability dependent on the size, shape, roughness and possibly other characteristics of the material being cleaned. These considerations affect the efficiency of the cleaning where several sizes, shapes and types of material are treated at one time.

A system of cleaning developed by E. I. du Pont de Nemours & Co., Inc., culminating in a plant at Weston colliery, Shenandoah, Pa. (*Coal Age*, May, 1938, p. 34), uses the principle of separation in a liquid at rest. The same principle has been used to determine either the amenability of coal to washing or the effectiveness with which coal already has been cleaned in a washing plant. This method of testing—the only one thus far developed—has been to immerse the product in a stable liquid of definite density and one that will not dissolve, or react with, any part of the coal substance.

Static Separation

This "float-and-sink test" gives a "static separation" without moving currents which operates regardless of shape or size of material. That portion of the material lighter than a definite specific gravity floats; the heavier material sinks. This static separation in a suitable high-gravity fluid, being the criterion for separability and for the accuracy of a completed separation, has been sought as a means of not merely testing but of making the separation. A way has been found by du Pont of attaining the desired objective by using heavy organic liquids that, unlike the zinc-chloride solution generally used in testing, are recovered readily from coal, are almost immiscible with water and, consequently, not susceptible to changes in concentration.

The Weston plant, which was operated experimentally by du Pont during the development stages, has since been taken over by the Locust Coal Co. and is being used as an auxiliary to the Weston breaker. Some changes were made in the equipment before the transfer to increase the plant capacity and to widen the range of sizes which can be cleaned. Formerly it would clean 50 tons of nut and pea per hour; today it is cleaning 100 tons per hour of feed consisting of a mixture of stove, nut, pea and No. 1 buckwheat in varying proportion, sometimes 15 per cent stove, 65 nut, 15 pea and 5 per cent No. 1 buckwheat. In Fig. 2, the size of the old breaker can be compared with that of the sink-and-float plant adjacent. The relative sizes of the two also can be visualized from the photographic illustrations.

The high-gravity liquid used for separation of coal from refuse, designated as "parting liquid," has the following characteristics: relatively low cost, chemical stability in presence of air, light, heat and water; inability to dissolve, or react with, the coal; liquidity under normal conditions, a viscosity about the same as that of water at all working temperatures, and an almost entire inability to mix or emulsify with water. Because of the almost complete immiscibility with water of the parting liquid, its specific gravity is not decreased because of the addition of any water that may arrive with the coal or that may be added to it for any reason. This is important because if water mixed readily with the parting liquid, the cost of expelling the water to reestablish the specific gravity of the parting liquid would be excessive.

Change in Parting Liquid

Originally the parting liquid used was pentachlorethane (C_2HCl_5), with a specific gravity of 1.678. This is now mixed with ethylene dibromide ($C_2H_4Br_2$), with a specific gravity of 2.17. Both of the densities recorded are those obtaining at 61 deg. By varying the proportions of these liquids, any desired intermediate density can be obtained. The specific gravity of the parting liquid being used at present is 1.70.

To prevent the solids that are to be cleaned from carrying away with them an excessive quantity of parting liquid, they are enveloped before cleaning with a tough liquid film of an aqueous "active-agent" solution such as an 0.03 per cent solution of starch acetate or a solution of tannic acid. The active agent is one of the most important features of the process because it reduces the quantity of parting liquid used to a low figure, thus making the process economically possible. Starch acetate is being used

Fig. 1—Sink-and-float plant dwarfed by the mammoth Weston breaker in the rear. As seen from rock dump.

at Shenandoah. This material costs 6c. per pound and about 35 lb. of it is used daily. None of the starch acetate is recovered, but the cost, being only $2.10 a day, is relatively insignificant when distributed over 700 tons of feed or roughly half that much coal.

About 8 oz. of pentachlorethane is used per ton of feed, which, at 10½c. per pound, is 5.25c. Ethylene dibromide costs 30c. per pound and, as about 1 oz. per ton of feed is used in operation, the cost is 1.88c. per ton. Total cost of parting liquid is, therefore, about 7.13c. per ton of feed. Pentachlorethane and ethylene dibromide are suitable components for such purposes, as they distill at about the same temperature. In the final recovery by steam distillation, there is no fractionation, because the proportion of evolved gases is the same as in the liquid mix. When, therefore, the gases condense, the liquid proportions remain unchanged.

The sink-and-float plant receives the tailings from the stove jigs, the coal end of the stove and nut rejigs, the tailings end of the pea-coal jig, crushed stove, nut and pea flats from the shakers as separated by Laubenstein pickers, with a cut from the middlings section of the No. 1 buckwheat tables. From 675 to 700 tons of this material is cleaned daily in a 7-hour run with a recovery of 55 to 65 per cent of merchantable coal, dependent on richness of feed.

The feed from the main breaker is delivered to a pocket in that structure and is then carried to the sink-and-float plant by a belt and chute. Increments of speed of travel and increments of load on the belt are multiplied continuously and automatically by a Merrick Weightometer, so that the increments of feed going into the DuPont sink-and-float plant, thus mechanically calculated, can be totaled by the machine and the tonnage over any given time determined to hundredths of a ton and to an accuracy, it is said, of 99 or 99½ per cent.

Speed of conveyor varies slightly with the load; hence the necessity for the concurrent determination of speeds and loads and for obtaining their several arithmetical products. By a similar scale, the coal leaving the sink-and-float plant also is weighed. At the end of June, the feed since Jan. 1 totaled 51,726 tons and from that 28,464 tons of coal had been recovered. Thus coal output was about 55 per cent of input.

The building, which is 48 ft. long, 40 ft. wide and 30 ft. high with a lean-to on the side for office and laboratory, is the same as was in use when the previous article was written.

The chute from the Weightometer delivers the feed inside the building onto a steel shaking pan, 12 ft. long, 3 ft. wide and 12 in. deep. Suspended on shaker arms, this pan, or "wetting-out" deck, is reciprocated by eccentrics and wood driving arms.

From above the deck, five manifolds, each of eight sprays, project the active agent solution onto the coal and thus coat it. By gently pushing the coal down the ⅜-in.-to-the-foot slope of the pan the sprays cause the formation in the pan of a number of small banks of coal equal to the number of manifolds. Behind these, water is held, and the rising solution covers the coal, which is further wetted as it passes under the spray, for the shaking pan brings the banks back under the several manifolds.

In this manner each piece of coal or refuse is enveloped in a tough liquid film of starch-acetate solution. The film prevents the parting liquid from coming in contact with the coal and precludes excessive liquid consumption. The treated coal goes to a dewatering and desilting screen which reciprocates with the "wetting-out" deck. The active-agent solution, which is recirculated, soon carries recirculated solids, but the quantity is kept down by settlement to 2 per cent. About 2 lb. of such solids is deposited for every ton of coal thus treated.

In the new and larger separator, or cleaning unit, which has a capacity of 100 tons of feed per hour, is a steel tank 27 ft. long, 44 in. wide and 10½ ft. high, and two flight conveyors which run in one vertical plane and carry coal and refuse in similar directions. Over the bottom of the tank is about 3 ft. of parting liquid with 2 ft. of water above it. In all, the separator contains 15,500 lb. of parting liquid. Several feed chutes carry the coated coal from the desilting screen into the water layer and distribute it evenly at one end of the tank.

Here particles denser than the parting liquid drop to the bottom into a flight conveyor. The clean coal either falls into the parting liquid and comes back up to the interface between water

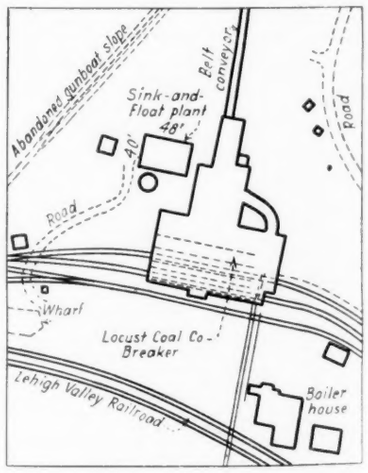


Fig. 2—Relative size of sink-and-float plant and old breaker.

and liquid or, being quite free from impurity, stays at the interface, floating partly in water and partly in the heavier parting liquid. The coal which stays at the interface or returns to it is designated "float," and the float, or upper, conveyor engages it by its lower strand, carries it up out of the liquid and delivers it to a 3-mm. wedge-wire screen.

The lower, or sink, conveyor takes the material that has sunk through the parting liquid and thence fallen to the bottom of the separator and lifts it out of that liquid with its upper strand, where it passes over a similar screen. It is important that the surface of the parting liquid be at the level of the bottom strand of the floats conveyor, so that this strand will travel where the coal lighter than the parting liquid will collect; in other words, at the interface.

"Washer" Removes Coating

Both separated coal and refuse fractions are discharged by gravity onto separate sides of a common shaker screen, called the "washer," where two fractions are scrubbed with water to remove the small quantity of parting liquid carried from the separator. The washer screen, which is totally inclosed in a steel housing, is suspended from hanger arms, is operated with the conventional reciprocating drive, and is dressed with $\frac{3}{16}$-in. perforated steel segments.

In the "washer" the sprays act as on the wetting shaker, forming seven banks of coal across the screen, one for each manifold, thereby flooding the coal and reciprocating the banks past the driving sprays of the manifolds, which, as the banks pass, beat down their lower sides. In the washer, recirculated water is sprayed under a pressure of 12 lb. per square inch and 800 to 1,000 g.p.m. is used for this purpose.

Coal and refuse each leave the "washer" through separate water-sealed conveyors. The washer screen underflow, consisting of a small quantity of solids, water and about 0.1 per cent of parting liquid, go together to a settling tank. The coal product is conveyed back into the breaker, where it is mixed with the breaker products and passed over sizing screens. Refuse is conveyed along with the breaker refuse to the rock bank.

The conical-bottomed settling tank is 25 ft. in diameter and 12 ft. high; it holds 40,000 gal. of water plus the solids and parting liquid carried from the washer. A rake in the center of the tank, only occasionally revolved, and then by hand, is used for moving the fine solids that settle out of the water.

Along the top of the settling tank is an inverted weir and gutter which collects any floating drops of parting liquid present and prevents them from passing over the rim of the tank. The larger droplets settle to the tank bottom, carrying solids with them. Parting liquid recovered from perforations in the gutter go by small pipes to join the other material settling in the tank bottom. Thus the water taken from the tank for recirculation through the sprays has a negligible percentage of solids and parting liquid.

Enough parting liquid collects in the settling tank to require its recovery for further use in the process. The parting liquid, solids and associated water are removed from the settling tank by a pump of 100 gal. per minute capacity. This sludge goes to a small settling cone having the same settling rate as the larger settling tank, where excess water is removed and returned to the settling tank. The sludge is discharged by gravity into a batch steam still, where less than 2 lb. of steam is used for each pound of parting liquid recovered.

Apparently, the purity of the water used in the process does not affect the operation of the plant. Mine water is being used at present. It is only mildly corrosive and does not require neutralization. The circulating water totals 860 g.p.m.

Power requirements are small; monthly averages of power aggregate 1½c. per ton of feed, nearly twice as much per ton of coal; cost of current is about 1c. per kilowatt-hour. The coal conveyor in the separator requires 5 hp. and the refuse line 7 hp.; 220-volt a.c. power is used. The washer uses in its sprays about 500 g.p.m. of circulating water. Losses are replenished by condensate from the still. The sprays which coat the coal with starch-acetate solution require 300 g.p.m. of circulating water which comes originally from the city mains; 30 g.p.m. of make-up water is needed from the same source. The condenser uses 50 g.p.m. of mine water during the five hours it is in operation, and the water-seal conveyors require a further 60 g.p.m. of mine water which is neither recovered nor recirculated.

The parting liquid is not one of those byproducts the output of which is dependent on the size of the market for some other chemical but is a liquid being produced on a large commercial scale for industrial purposes and, therefore, one that will be steadily available. Outside of the water seals, no precautions need be taken against gases, though gas masks are used when the equipment is cleaned out; pockets, sumps and low places are ventilated and all surfaces are washed with water and kerosene before any repairs are made. The coal product of the plant goes back to the breaker, is screened, and goes to the several breaker pockets. Because power and maintenance costs are low and degradation at a minimum, running costs of the plant are reasonable.

Shortly after the plant was sold to the Locust Coal Co. the Du Pont staff was withdrawn and the plant is now being operated by four men, including T. R. Jolley, assistant to William Johns, manager in charge of preparation. Operation is practically foolproof in the hands of one familiar with the process. T. M. Dodson is president of the Locust Coal Co., and B. H. Stockett, general manager.

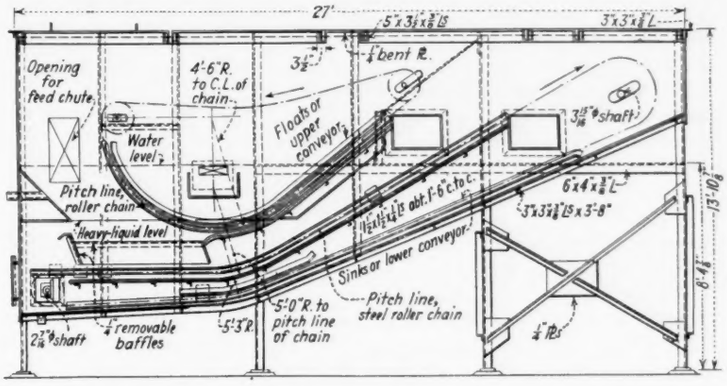


Fig. 3—Cross-section of separator in which sinks and floats part company at a definite gravity.

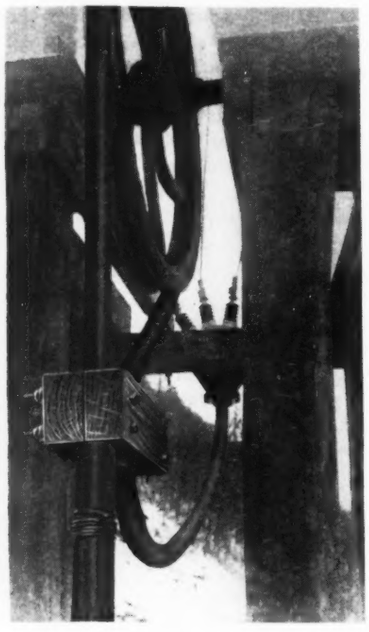
BOREHOLE CABLE

Suspended From Large Sheave Minimizes Strain on Non-Metallic Sheath

By J. F. DANGERFIELD
Chief Electrician
Cannelton Coal & Coke Co.
Cannelton, W. Va.

IN THE SPRING of 1938, the Cannelton Coal & Coke Co., Cannelton, W. Va., was faced with a severe problem of transmitting 3-phase 60-cycle alternating current at a potential of 2,300 volts into an extension of its mine workings for operation of motor-generator sets and pumps. A borehole had been drilled approximately 300 ft. in depth, but, unfortunately, the ultimate capacitly had not been anticipated and, due to a curvature, as a result of difference in rock structure which occurred in the drilling, a 3-in. casing was the largest which could be used.

An installation of three No. 2 B. & S. gage single-conductor cables was first made, but a failure occurred and it was decided that such capacity was inadequate and to install the maximum cable size the pipe would accommodate. After some consideration and discussion it was decided to use a cable with non-metallic sheath, in order to take advantage of maximum flexibility and utilize all available space for conductor capacity.



The large sheave with padded groove is easy on the insulation.

A three-conductor cable consisting of stranded copper conductors, each 350,000 circ.mil capacity, individual conductors having 11/64-in. versatal performite rubber insulation, tape and copper shielding, with a 8/64-in. sheath of 60-per-cent non-hygroscopic rubber over all was recommended by the engineering department of General Electric's cable section. This cable was rated at 5,000 volts with a current-carrying capacity of 250 amp. per conductor and an outside diameter of 2.54 in.

Suspension by individual conductors appeared too risky, as the adjustment of tensions might bring about some distortion and derangement of the conductors within the sheath, and possibly some tension on the copper shield, causing it to cut into the insulation on the individual conductors. Suspension by clamps on the sheath was dangerous, since the compression required to support the weight of the cable was almost sure to cause an ultimate breakdown at the point where the bottom clamp was applied.

E. D. Knight, Virginian Electric, Inc., suggested a sheave method of support with the strain taken by the friction of the cable lying in the groove around the circumference of a large sheave. This was approved by the General Electric engineers and the installation laid out on this basis.

The bottom groove of a used incline sheave 5 ft. in diameter was filled with 1¼-in. round iron and then lined with burlap and friction tape to provide a cushion for protecting the cable insulation. A supporting structure of timber was erected over the borehole and the sheave positioned so that from one side of it the cable would run directly into the center of the borehole. A heavy steel plug, similar to a well driller's tool, with a sharp edge on the bottom, was dropped through the hole on a light steel cable to clear away any irregularities in the casing. On the hillside below the borehole, the reel on which the cable had been shipped was mounted on jacks so it

This permanent cable supporting structure and sheave served also during installation.

would turn and the end of the cable was fed over the sheave and into the borehole.

After the end of the cable was fed down the hole until the balance point was reached, the remaining cable was stretched out and the end anchored to a tractor-type bulldozer which was used to feed the cable the remaining distance into the hole. Workmen then took hold of the cable, allowing the bulldozer to slack it up, and brought the slack back around the sheave. A wooden clamp was loosely applied simply to hold the cable in position around the sheave where the friction maintained the support. The sheave was permitted to rotate until it had reached the point of natural balance, when it was locked in place and the wooden clamp was lightly tightened. A flared shield was placed over the top of the casing and filled with compound to keep moisture from the cable.

Where multiple conductor cables are to be suspended in boreholes — other than those having an outside armor of round wires which may be used as a support — some method of suspension where the cable lies in a groove over a wide arc and supports itself by distributed friction with no sharp tension at any point to cause distortion or unequal conductor strain is most desirable.

The cable was terminated at both ends with four-conductor G. & W. potheads, the three copper shields in each instance being brought together at one terminal and thence carried to an adequate ground. The casing also was grounded.

The method used in this instance actually involved no additional expense over what would have been considered normally a cheaper and more orthodox method. First, the sheave was worn out as far as further service on wire rope was concerned and was purchased at scrap value; second, it would have cost at least as much to provide any other method of lowering the cable in the borehole as it did to erect the structure and mount the sheave.

In addition, if at any time it is desired to remove the cable it can be done quickly and without damage by unlocking the sheave and allowing it to rotate.

HYDRAULICKING

Found Cheapest Aid to Stripper In Deep Overburden Spots at Bobolink Mine

TAKING a leaf from the placer miner's books, the management of the Bobolink strip mine of the Binkley Mining Co., Seeleyville, Ind., is knocking the top off the deep spots along one boundary line with high-pressure water streams. Thus the stripping unit is able to work up to this boundary and turn without spoiling difficulties. Hydraulicking, rather than dragline, scraper or truck-and-shovel disposal, was chosen, first, because the investment is substantially lower and, second, because it makes it possible to take the spoil far enough away so that it never will have to be rehandled.

The stripping unit at Bobolink is a Bucyrus-Erie 950-B electric shovel with 105-ft. boom, 72-ft. dipper handle and 30-cu.yd. "Man-ten" dipper. Effective dumping height is 70 ft. above ground level and the dumping range is 106 ft. On a slight outside curve or even on a straightaway, the shovel can spoil 60 ft. of overburden without undue difficulty. In the section being hydraulicked, however, which consists of a strip about 300 ft. wide lying along one property line, thickness of the overburden runs 60 to 70 ft. The pit is at right angles to the line and consequently the shovel must work up to this line and turn directly right about face in the area having this thick overburden.

The overburden thickness cited above was in itself a compelling argument for shovel assistance, not to mention the possibility of slides on both the high wall and the spoil bank. The form of assistance was another matter. With a dragline, even though it worked on the surface, a large long-boomed unit would have been required, meaning a correspondingly heavy investment. Furthermore, all the unit could do would be to move the dirt to another location where it still would have to be handled by the shovel. And if the dragline worked in the pit, especially in one end, as in this case, interference between the drag and the shovel would have been multiplied. Tractor-powered scrapers were another possibility, but this equipment, like a dragline on the surface, could only move the dirt to another location. Lack of suitable dumping sites within a reasonable distance, plus high investment and labor costs, also ruled out truck spoiling.

In the light of these considerations

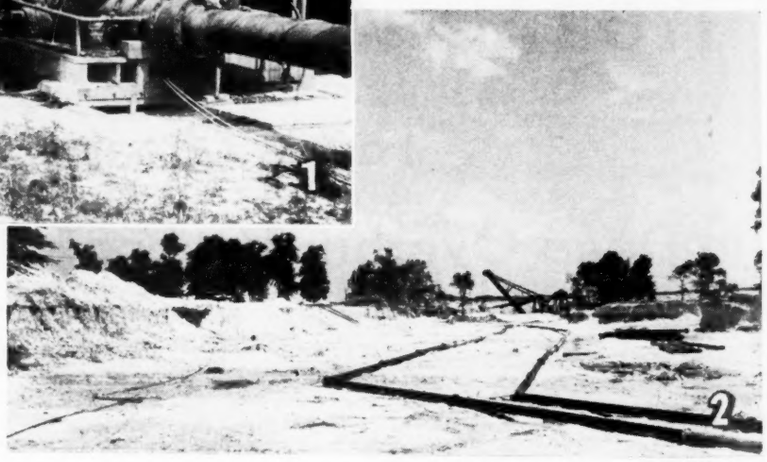
and the fact that the material to be removed lent itself to this type of operation, the decision went to hydraulicking. Water is used, however, only in the removal of 10 to 20 ft. of material down to the hardpan, which cannot be cut economically with water. Average thickness of the material removed by hydraulicking is 14 ft. and, in addition to surface soil, it ranges from clay and quicksand to sand and gravel, the latter frequently containing small boulders up to 8 to 10 in. in diameter, with some even larger. All this material is pumped completely away, leaving the shovel an average of 45 ft. of rock and hardpan (40 ft. minimum, 50 ft. maximum, as a general rule).

Hydraulicking at Bobolink involves three major steps: (1) washing down the material; (2) pumping it away to the disposal site; and (3) recovering the water for reuse in the nozzles. Three high-pressure nozzles (Georgia Iron Works and Allen-Sherman-Hoff) are included in the system, each fed by an 8-in. spiral-welded pipe line branching off from a 14-in. main. Each nozzle is accompanied by a small auxiliary nozzle for clearing the ditches which carry away the mixture of spoil and water. The nozzles are supplied with water at a pressure of 175 lb. per square inch by two 350-hp. Morris 14-in.-double-suction 12-in.-discharge centrifugal pumps in series. Individual pumps are rated at 4,500 to 5,000 g.p.m. against a dynamic head of 231 ft.; in series, the rated dynamic head for the same delivery is 400 ft. The pumps draw their supply from a clarified-water storage pond.

Spoil knocked down by the nozzles flows with the water through ditches to a sump feeding the mud pump. This pump, an Allen-Sherman-Hoff "Hydroseal" unit, 14-in. suction and discharge, is driven by a 500-hp. Westinghouse Type CW wound-rotor (five-

These two centrifugal pumps in series supply the monitor nozzles from the storage pond in the background.

Looking back along the boundary line showing the hydraulicked area with the stripping shovel in the distance.



Spoil and water flow into the sump feeding the mud pump, which forces the mixture to a pit about half a mile away.

Looking across the pit toward the boundary on the opposite side, with two nozzles in operation.

speed) motor, and will handle small boulders up to 8 in. or more in diameter without difficulty. Pump and motor are mounted on a sled with a boom in front for raising and lowering the suction pipe.

The mud handled by the Hydroseal unit is pumped to a settling pond made by damming an old cut. The pumping distance is approximately one-half a mile. In this pond, solid material settles out and the water flows around and through a gate to a "jack pump," another 175-hp. Morris 14-in.-double-suction 12-in.-discharge unit, which elevates the clarified water to a ditch, through which it flows approximately one mile back to the pond serving the nozzle-feed pumps. Mud lines, jack-pump lines and nozzle-feed lines are a mixture of spiral-welded, plain-welded and flanged pipe.

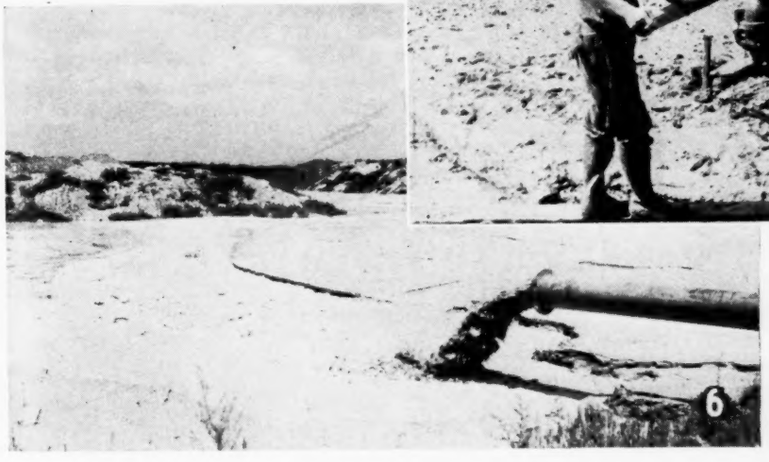
Since the spoil material, as described above, is pumped away into an old pit, it, of course, never has to be handled again.

The hydraulicking unit works 21 hours per day and is operated by crews of five to six men per shift, including mud-suction and pump tenders. Breaking a supply line and moving a nozzle ahead requires about 30 minutes, as a rule, while moving the mud pump up, including digging a new sump, requires about 1½ shifts.

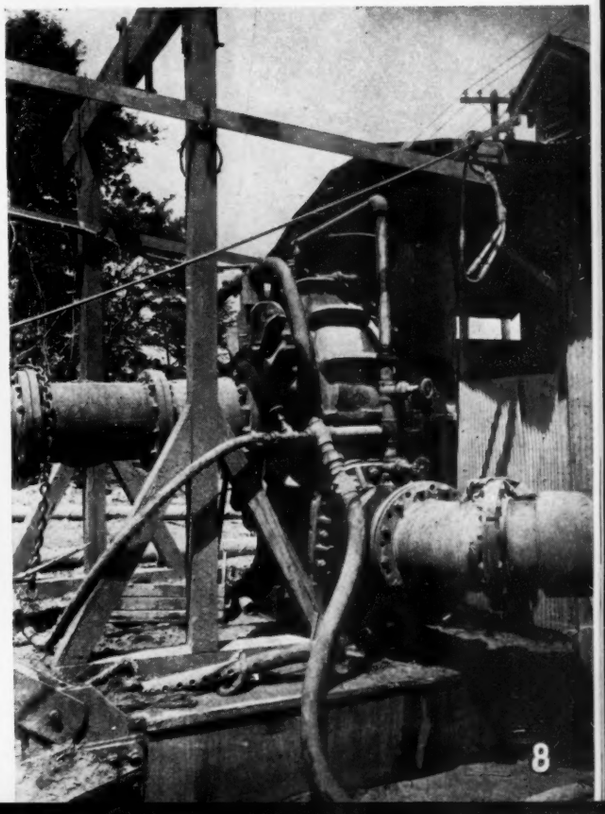
Hydraulic stripping was inaugurated in August, 1939, and, after shutting down January, February and March on account of cold weather, was resumed again in April of this year. The work will continue along the boundary and in a few adjacent thick-overburden patches until some time in 1941. Depending upon the material, the output runs from 3 to over 10 cu.yd. per minute. Up to June 30, this year, the unit had operated 2,331 hours and 57 minutes, moving in that time 1,350,000 cu.yd., or 9.65 cu.yd. per minute of operating time.

Close-up of a nozzle knocking down a bank. Drainage ditches are cleaned out with auxiliary nozzles.

Discharge end of mud line in a settling pong made by damming an old pit.

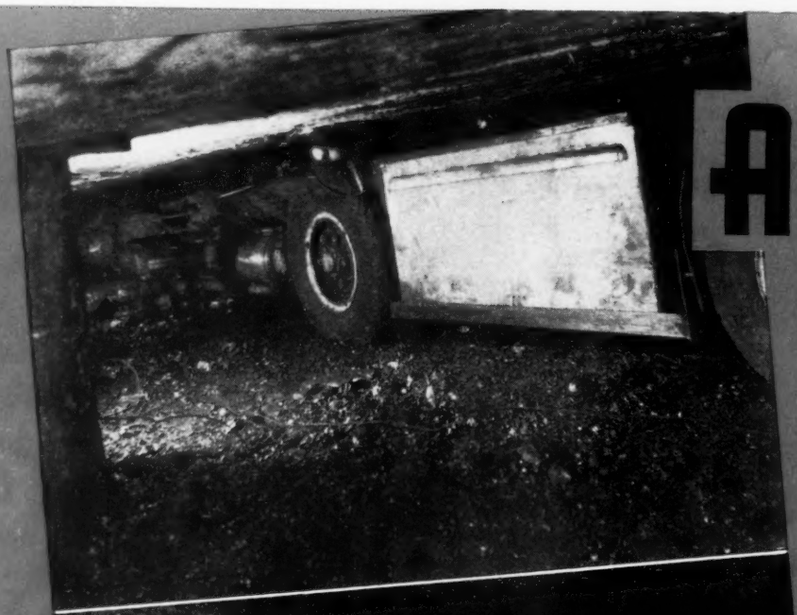


This pump, driven by a 500-hp. variable-speed motor, handles the spoil and water at Bobolink.



This "jack pump" starts clarified water back toward the nozzles via a ditch.

A GOOD



Joy 14 BU Loader loading into 32" Shuttle Car in 38" coal.

Another view of Joy 14 BU Loader in same mine as above.

Joy 7 BU Loader loading into Shuttle Car.

Tapered Roller
TIMKEN BEARING
EQUIPPED

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

COMBINATION

for Coal-Handling Economies

Users of Joy Loaders and Shuttle cars report substantial savings in moving coal from working faces to main line haulage way. They are able to get out more coal per shift at a lower cost per ton.

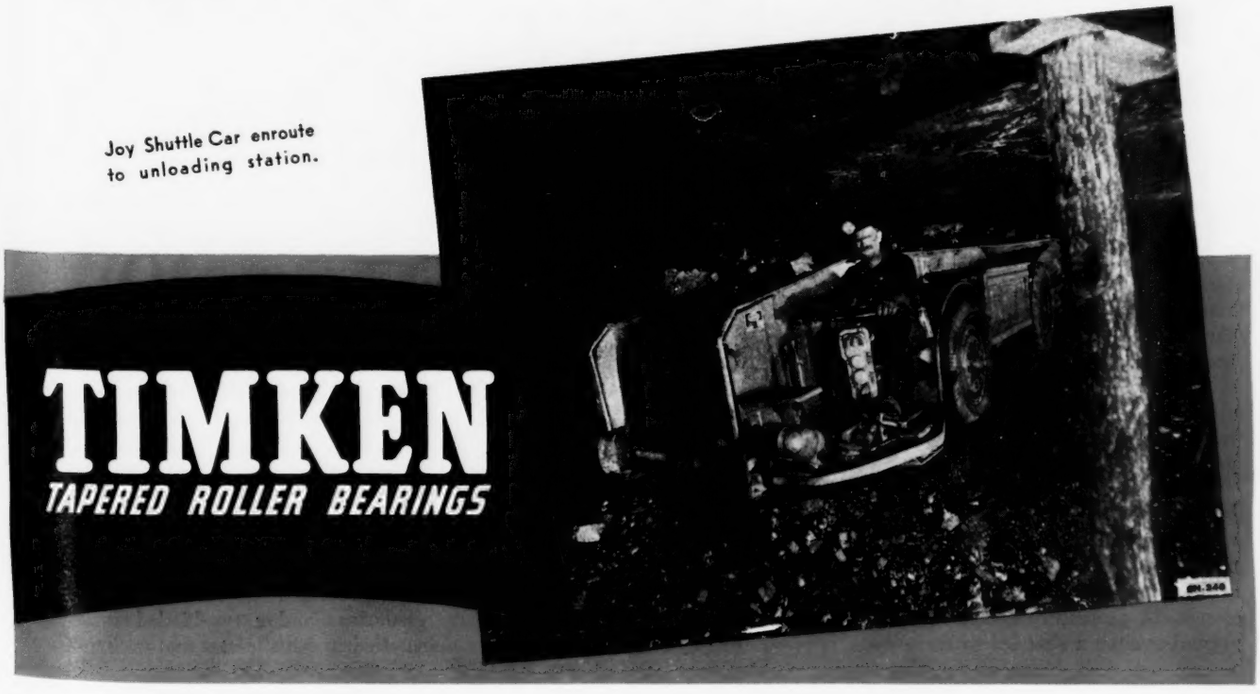
The Joy Manufacturing Company long ago recognized the vital importance of anti-friction bearings in coal handling equipment. TIMKEN Tapered Roller Bearings have been used in Joy Loaders for years. Thus when the Joy Shuttle Car was developed it was natural that TIMKEN Bearings again should be specified.

The scientific design of the TIMKEN Bearing, the material of which it is made (TIMKEN Electric Furnace Alloy Steel), the precision with which it is manufactured and the fineness of its finish form an unequalled combination for efficiency, economy, endurance and low maintenance in mine cars, loaders, conveyors, hoists and every other kind of equipment.

There is no substitute for the 42 years of experience behind the TIMKEN Bearing and no substitute for the experience of users of Timken Bearing Equipped machinery.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Joy Shuttle Car enroute to unloading station.



STRAY ELECTRICAL CURRENTS

Create Serious Blasting Hazards

When Grounding of Equipment Is Inadequate

By PAUL C. ZIEMKE
Milwaukee, Wis.

INCREASING electrification of mining operations makes the detection and elimination of the ubiquitous "stray," or "sneak," current a safety problem which should not be underestimated. Such currents present a serious hazard in electric blasting and where there are explosive gases. Although electric blasting is inherently the most efficient and safest firing method, it is not proof against the danger of stray current flowing into the blasting circuit.

National and State electrical codes require the grounding of practically all electrically powered units, supply lines and substations as a safeguard against insulation failures, accidental contact with foreign circuits or lightning stroke. Even these provisions, however, do not necessarily make conditions safe for electric shotfiring. Quite frequently ground connections that are structurally strong and mechanically perfect are not acceptable from the conductivity standpoint because of their relatively high electrical resistance.

Results of Bad Grounds

Under such conditions, an appreciable difference of potential between the supposedly grounded equipment and the ground is present. This potential may readily cause stray currents to seek low resistance paths to the earth—especially through a blasting circuit. An electric detonator offers only approximately 1½ ohms electrical resistance and fires readily from one small cell of the fountain-pen-type flashlight battery.

Minnesota mines formerly "caved back" certain timbered headings by electrically primed half sticks of dynamite inserted in the posts, connected in series and fired from the trolley circuit. A premature explosion while preparing such a shot led to an investigation which revealed dangerous quantities of ground currents present. As corrective measures, all bonds and ground connections were checked. In addition, each charge was primed with a short section of detonating fuse and in turn spliced to a trunk line and the charge detonated by time fuse and cap.

Investigation following a premature dynamite explosion in a Midwestern mine disclosed that the 1,000,000-circ.mil base negative cable passed under the headframe at a point where the leaking soil pipe of a urinal resulted in chemical decomposition that almost severed the cable. This highly corroded spot caused most of the return current to seek other channels and, incidentally, a decided rise in potential on all rails, conduits, water lines and the steel shaft timbering. Fully 90 per cent of the current was returning to the generator by way of a 6-in. compressed-air line because that line extended into the power house and was in contact in numerous places with the bare negative between the generator and the corroded section.

Testing a bonded joint with a duplex millivoltmeter.

Had this cable been cut through suddenly, the effect would have been apparent immediately to practically everyone connected with the operation of the affected machinery. Since the condition became slowly aggravated during a period of several years, it had escaped notice. All too often such bad conditions are tolerated simply because no serious accident or breakdown occurs to arouse proper action.

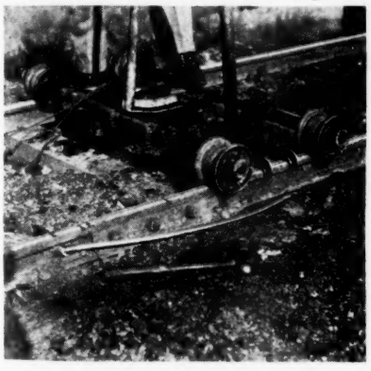
Bad-Grounding Example

A circulating pump motor functioning on a hoist-motor liquid rheostat in a metal mine started and continued to run for several hours without the starting switch being operated. Subsequent investigation disclosed that an underground pump had developed a ground in its controllers. This unit was powered from the same 220-volt transformer bank as the motor operating the rheostat. The circulating motor was a single-phase repulsion-induction type controlled by a single-blade switch. This switch was in phase *B*, which became grounded in the mine. Later when the rheostat motor developed a ground it occurred on phase *C;* thus the motor ran with the control switch open. That condition could not have developed if the 220-volt secondary had been grounded according to code regulations and a two-bladed switch installed in the rheostat motor circuit.

Absence of electric power in a mine, however, does not necessarily indicate the non-existence of stray currents. Enormous quantities of electricity are constantly flowing through the earth, seeking return paths to the source from which they originated. Power, street railway, telegraph and telephone companies all depend to a large degree on the effective current-carrying capacities of the earth. In some instances, these ground currents are the sum total of the return current of various electrical circuits; in others, connections to ground are merely established as effective escape paths for lightning or accidental contact with high-tension circuits.

Steam and Stray Currents

A Far Western mine using steam and compressed-air power, nevertheless, had trouble with ground currents. Electric shock could be experienced standing on the rails and in contact with the compressed-air lines. Voltmeter tests indicated current surges up to 5 volts at intervals, but no one spot showed a consistently high voltage reading. A spot apparently devoid of current would



A portable electric rail drill prepares the rail for the application of a wedge bond.

suddenly activate the needle for a moment or two and then quickly drop off.

Disturbed over the disintegration of the lead sheath of its underground toll cables by electrolysis, a telephone company placed several graphic voltmeters at strategic points along a 90-mile run of these cables. At one point where the telephone cables paralleled an electric railroad, sharp voltage fluctuations distinctly indicated the line surges produced by the movement of the motorman's hand advancing the controller handle to accelerate speed.

Similar tests on a ten-block length of city telephone cable showed that no appreciable current flowed from or to the lead sheath in the center of the cable's length. Nearing the power house, however, current flow *to* the cable sheath increased; progressing from the central point, current flow *from* the sheath increased. This indicated that the ground currents leave or enter a conductor as the surrounding conductors increase or decrease in electrical resistance. The factors which govern such conditions are the conductivity of the soil or rock, the size and number of near-by gas or water mains and the condition of the electrically bonded rail joints.

Electrical discharges from the clouds often present a serious hazard while explosives are handled in underground work. A lightning bolt striking the headframe of a South African mine found its way underground over the electric signal system, causing a premature explosion which killed eight men and injured four others engaged in loading a blast.

In another case, a blown electrical fuse end lying on the switch tower of a 33,000-volt line serving a mine substation so thoroughly charged all the immediate vicinity that near-by telephone, telegraph and radio equipment was put out of commission. The short-circuited current found return paths up through the various ground wires. Tests were made underground with electric squibs. These could be readily fired when the wire ends were touched respectively to a water line and the rail or to the compressed-air piping and the negative return wire of the haulage system.

Detection Not Difficult

Detection of ground currents in volume sufficient to cause a blasting hazard is not difficult. An ordinary magnetic voltmeter with the scale reading from zero at one extremity, however, should not be used. Such instruments register only when the polarity (direction of flow) of the ground current coincides with the polarity of the voltmeter. A meter with the needle at rest on zero in the center of the calibrated scale is recommended. With this type of instrument, currents flowing in one direction or reversing rapidly are at once detected and noted.

Lacking such a voltmeter, reasonably reliable tests may be made with the ordinary electric squib. These squibs contain the same bridge wire and have the same electrical resistance as the ordinary electric detonator. Currents too weak to fire a squib, therefore, will offer no serious

A close-up of a copper arc-welded terminal bond.

hazard to blasting circuits. A radio or telephone head set may be used to supplement the squib test. These receivers, closely fitting the ears, exclude extraneous noises and permit one to detect easily the peculiar hum or buzz common to all minor currents. With practice, the user can identify sounds and currents as originating from a particular machine. The rhythm or sequence of tone usually gives a clue to the identity of the offending motor or line.

Preventing Stray Currents

Local stray or ground currents set up by electrical lines and machinery can be prevented to a large extent by thorough and proper grounding of all low-voltage secondary power lines under 440 volts. Power cables serving portable electrical equipment should have an additional conductor securely bolted to the frame of the driven unit at the one end and to a tested and permanent ground at the other. For the power-house ground it is advisable to dig down to permanently moist earth and there place a large metal plate or several hundred feet of used trolley wire laid in concentric turns and embedded in layers of coke for better conductivity. Such a ground is preferable to numerous ground rods driven into soil of doubtful moisture content and poor electrical conductivity.

In many cases, it is almost impossible to secure an adequate ground in a mine. All too frequently grounding is attempted by using the negative side of haulage circuits in conjunction with the cross bonding of rails and pipe lines. This, however, is a rather hazardous practice, especially when high-voltage equipment and their accompanying lightning arresters are so grounded. In such cases, serious ground currents may

develop and create a dangerous condition which can be corrected only by the installation of a separate and adequate ground lead, either in a borehole serving the substation or in the entry tunnel.

To provide good voltage, all rail joints, frogs and switch points must be securely shunted or bonded by electrically welding or riveting copper cables around them. Cross bonds from rail to rail also should be installed at various convenient points, as well as cross bonds from rails to water and air mains. Periodic inspection and ohmmeter tests will readily reveal defects or need for additional bonding. One recognized authority states that the voltage drop should not exceed 12.5 per cent on haulage or d.c. distributing lines. The current-carrying capacity of a trolley system is governed by the size of the rails, quality of the copper and the efficiency of the bonding. Tests have proved that rail bonds should be within 35 per cent of the rail capacity. One poor bond may cause a serious voltage drop and subsequent bypassing of the current to other conducting elements.

Raising Voltage Suggested

There is a point in conductor capacity where the delivered capacity is at a minimum. Raising voltage at the generators and substituting 6-0 A.W.G. trolley wires for a conventional 4-0 is a suggested remedy. In some instances No. 9 wire (400,000-circ.mil deep section), which is practically twice the cross-section of the 4-0 size, is being installed, together with heavy rails for larger equipment. One objection to raising voltage is the attending hazard of increasing the leakage in trolley hangers and feeder cable. Maximum permissible leakage for trolley hangers should not exceed 50 milliamperes. Ground currents originating outside the premises cannot be eliminated, but properly bonded conducting elements tend to drain them away harmlessly as they flow through rock strata or rail and pipe lines.

Maximum leakage from hangers should not exceed 50 milliamperes.

There is no economy in using a very light rail since the base generally is gradually eaten away by mine water when it comes into contact with the metal or by electrolysis. With heavier sections, it will be much longer before the rail becomes weakened. On main haulageways where heavy locomotives are used, the weight of the rail should be regulated by allowing one ton for each driver for each 10 lb. of weight of rail per yard.

Burn-Outs Undesirable

Power networks in mines have one feature quite distinct from public-service networks. In the latter, it is common practice to allow cables to burn themselves clear with automatic sectionalizing switches; such practice in mines invites the dangers of excessive ground currents. Defective cables should not be permitted to burn themselves clear unless due caution is taken to prevent personal injury. Such "burn-outs" may raise the potential of rails and pipe lines to dangerous values.

Adequate testing equipment, fast operating circuit breakers and prompt acting relays are very necessary in mining work. The insulation of the cable, its conductors and the inclosing sheath must have inherent strength to withstand the forces of short-circuit currents and surges of high voltage. Insulation values must remain high to prevent contact from conductor to conductor or to ground. Cable installed under tracks must be protected from crushing with a section of pipe or a concrete culvert. At all points where cables are not otherwise protected, hardwood planks should be laid on them before backfilling the trench. Such planks provide adequate safety against future digging hazards with picks and bars.

In selecting and installing cables, consideration must be given to possible damage from: (1) moisture, oils, acids, alkalis and electrolytic action of ground or stray currents; (2) derailed locomotives, cars and rolling equipment; (3) falling rock, coal or moving of timber through caving or heaving; (4) contact with trolley wire or passing trolley wheels of locomotives or by accidental puncture with a pick.

Cables used for high-tension power circuits in mines usually fall into two major groups: those with non-metallic armor and those with metal armor. The former, commonly known as flexible or soft cables, have an outer covering of tough, pliable rubber over the individually insulated inner wires, whose valleys are filled with tar-impregnated hemp to round out the construction.

Metal-armored cables include those in which flat steel tapes, interlocking steel tapes and steel wires give protection to the regular insulation and also serve as a grounding medium. To be really effective, this sheath method of grounding must be independent of the haulage circuit and electrically continuous over the entire length of cable. To accomplish this, effective shunts must be installed at all points where splices and repairs are made.

Preparing to weld the terminal of a steel arc-weld bond in the mine.

Should Ground Armor

For effective grounding of armored cables the armor should be thoroughly grounded at its underground terminus and at the power house; contact should be avoided with grounded construction along its length unless the shaft and entry timbering is steel. In that case, the cost of insulated attachments would be prohibitive.

Allowing a broad margin of safety in specifying insulation for cables increases the initial cost but guarantees a much longer period of service free from insulation failures and the resultant dangers of shock, fire and loss of production. Recommended practice is to substitute 5,000-volt insulation for the regulation 2,300-volt, and 8,000-volt insulation for 3,800- to 4,100-volt circuits.

KENTUCKY TRUCK BANK

Grows to 460-Ton Electrified Mine In Four Years of Mechanical Development

Reinvestment of earnings in progressively better equipment has developed the Moore Branch truck mine to a production close to 500 tons per shift in a few years. Undercutting, haulage, slope conveying, screening and rescreening are now electrically powered. The coal contains less than 2 per cent ash, averages 56 in. in thickness, is without regular partings and the available acreage is 873. Situated only 20 miles airline from Ashland, Ky., the mine is in an area heretofore undeveloped.

By J. H. EDWARDS
Associate Editor, Coal Age

RAPID growth, self-financed — the sign of a healthy local industry— has taken place at many truck mines in recent years. Usually, through necessity, the start is made with rebuilt equipment, but, when expansion occurs, new machinery comes in for its share of the business. Moore Branch Coal Co., near Willard, Carter County, eastern Kentucky, is an outstanding example. Starting from scratch in 1935 with ponies and a few mine cars, it rounded out 1939 with a well-equipped, fully electrified mine producing as much as 460 tons in a single shift.

Mine Production Up

For many years, George Stephens, owner of Moore Branch, was superintendent of a captive operation of General Refractories Co. at Hitchens, Ky. When that mine was worked out, the district was left without a producer of appreciable capacity and the stage was set for the new development. In 1936, Moore Branch produced 19,432 tons; in 1937, the output was 30,284 tons; the next year it was 31,294 tons and last year it rose to 51,639 tons. Indications point to 75,000 tons in 1940. A tract of 873 acres in one block is available to the mine.

The coal, known locally as the Moore Branch seam, is blocky and resembles the Millers Creek or Van Lear bed. It is free from regular partings and averages 56 in. in thickness. Maximum thickness so far encountered has been 60 in. and in only two or three places has it dropped to 30 in. General dip is 3 per cent to the east and local grades reach 10 per cent. Cover ranges from crop to 300 ft.; at the tipple, which is near the center of the property, the cover is 50 ft.

Occasional lenses of pyritic sulphur are the only visible impurities. A channel sample, taken in 60-in. coal and submitted to the University of Kentucky for analysis, brought the following report: Moisture, 6.09 per cent; ash, 1.28; volatile matter, 37.89; fixed carbon, 54.74; sulphur, 0.65 per cent; B.t.u., 13,740; ash-fusion temperature, 2,720 deg. F. All percentages given are on an "as-received" basis.

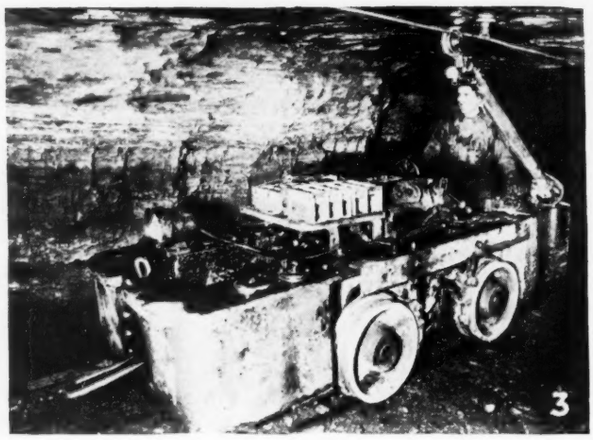
Immediate top over the coal is 18 to 20 ft. of firm blue shale; above this is a strong, thick sandstone. In a few places, drawslate up to 4 in. has been encountered. As a whole, the bottom is a hard, sandy shale. Rooms are driven 24 ft. wide, 200 ft. deep. Pillars are left in place for possible recovery on final retreat. Coal is undercut, drilled by hand with post augers, blasted with King black powder and Beaver fuse, and hand loaded directly into mine cars without yardage expense.

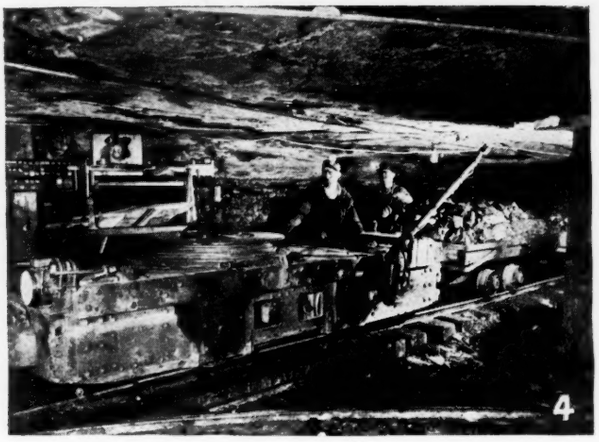
Moore Branch mine was opened by driving a 10-deg. slope and using ponies to deliver the loaded mine cars to a truck-loading bin, without screening. In 1936, a tipple with mine-car scale, gravity bar-screen and storage bins was built on a hillside 200 ft. from the slope portal. A hoist driven by a Packard-8 automobile engine was installed at the tipple to pull cars out of the mine slope and up a graded incline to the tipple dump. This hoist was fitted with 500 ft. of ½-in. rope.

Diesel Makes Power

The 1937 improvement program included the purchase of a new 100-hp. type D-8 International diesel engine, connecting this to a 75-kw. 275-volt direct-current General Electric generator, purchasing a rebuilt Sullivan CE-7 shortwall machine with 6½-ft. standard bar and installing a 4-ton haulage locomotive. The generator was part of a motor-generator set of which the alternating-current motor was in bad condition. The motor rotor was removed and in its place a new shaft was installed to transmit power from the engine to the generator. This diesel-electric power unit has since been supplemented by a steam plant and now serves as a spare to insure an uninterrupted supply of coal to fire brick kilns at Hitchens in case of failure of the steam plant.

The 4-ton locomotive is a Whitcomb which was converted from gasoline to electric power. The gasoline engine and its transmission were removed and replaced by a G.E. series-wound crane motor rated 80 amp. 550 r.p.m., with a maximum allowable speed of 2,200 r.p.m. Due to a relatively low gearing





1—Undercutting a 24-ft. room in 4 ft. of clean coal with the mining machine last purchased.

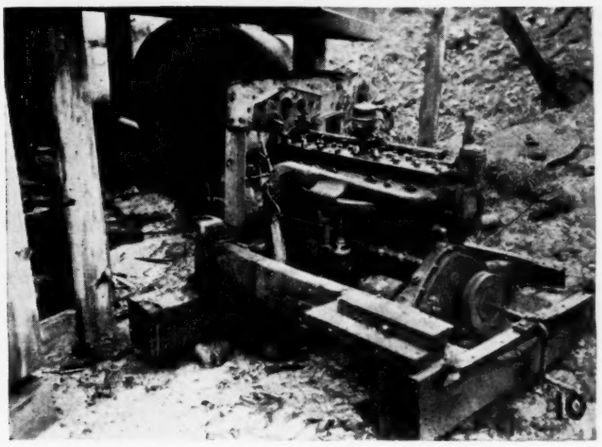
2—Loading in a 24-ft. room in 4½ ft. of clean, blocky coal with hard bottom and strong roof.

3—This, the first locomotive to be acquired, is a single-motor unit in which a crane motor replaced the original gasoline engine.

4—The 4½-ton cable-reel locomotive pulling over the mine-car scale as it delivers a trip to the bottom.

5—George Stephens, right, watches a car approach the dump. Lumps in background are on flight feeder delivering to slope belt conveyor.

6—William Thomas, mine foreman, starts one of the two belt-driven pumps. All stationary motors have inclosed starting rheostats.



7—Left to right: Slope portal, slope-belt conveyor gallery, main tipple, rescreening plant and bins, ground lump storage and power plant.

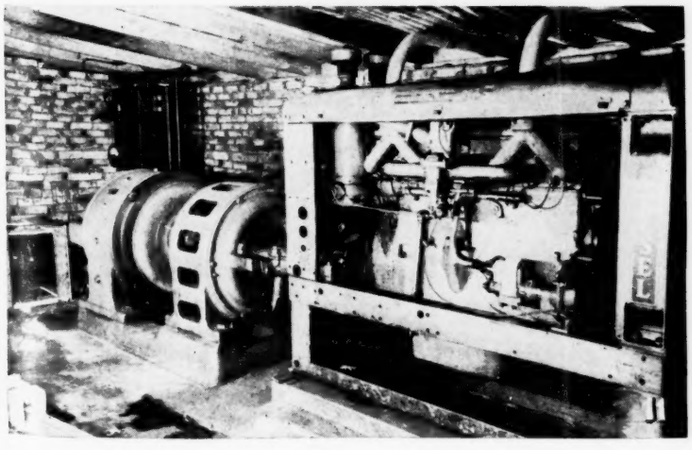
8—The new tipple with shaker and vibrator displaced this 1936 structure, which had only a gravity bar screen.

9—Lump is stored on the ground adjacent to the power plant.

10—This Packard automobile engine, now retired, was the first power unit at the mine.

11—This 100-hp. diesel, purchased new and connected to a 75-kw. 275-volt d.c. generator, was the second power unit. It now serves only as a spare. The motor of the m.g. set is only a shell—a shaft goes through it from engine to generator.

12—The latest power source—a 150-kw. steam plant—operates eight hours per day.



of approximately 3 m.p.h. at full load and the fact that the axles are connected by roller chain, this single-motor locomotive has given excellent satisfaction for the short hauls (3,000 ft. maximum) developed to date. The locomotive is equipped with cast-iron wheels.

Increasing demand for coal called for a second mining machine, so early in 1938 a rebuilt Goodman 112AA Universal with 7-ft. standard bar was added. Soon it became apparent that greater generating capacity was required and that the new capacity should be sufficient for an additional locomotive and for the motors of a proposed new tipple with mechanical screening and conveying facilities. Accordingly, later in 1938, a 150-kw. steam-driven 275-volt d.c. generating plant was put in.

This plant has two 150-hp. hand-fired horizontal-return tubular boilers with stationary grates and a direct-connected 18 x 18-in. Ridgway engine-generator. A 42-in. x 60-ft. steel stack is supported independently on a brick foundation on the hillside next to which the plant is built. Boiler feed water is pumped from a 235-ft. deep-well with a Cooke steam pump; the water requires no treatment. The power plant was assembled principally from rebuilt equipment.

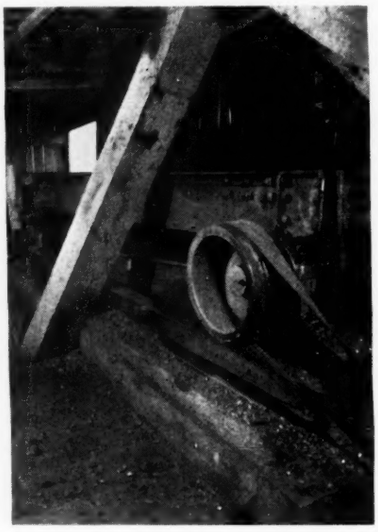
Locomotive Purchased

The first improvement of 1939 was the purchase of a two-motor 4½-ton G.E. cable-reel locomotive equipped with steel tires. At present it gathers and hauls to the bottom from one half of the mine. In the other half, where the Whitcomb locomotive hauls to the bottom, gathering is still being done with ponies.

Later in 1939, a 16-deg. slope was sunk, a new bottom developed, and a slope belt conveyor and a new tipple with shaker and vibrating screens were installed. A new Winslow 13,000-lb. mine scale was purchased for the mine bottom. Cars are tipped in a horn dump and the coal is fed by a flight conveyor from the dump hopper to the slope belt conveyor. The latter, delivering to a Link-Belt shaker screen in the tipple, is 30 in. wide and has a centers distance of 130 ft. The small size coal from the shaker, usually minus 2½-in., is taken by a 24-in. x 60-ft. flight conveyor to a Roberts & Schaefer double-deck vibrator.

Direct-current motors driving the plant are: underground feeder, General Electric 3 hp.; slope belt and shaker, G.E. 35 hp.; flight conveyor, Westinghouse 10 hp.; vibrator, G.E. 5 hp. Other stationary motors in use at the mine are: A 25-hp. G.E. driving a 6-ft. propeller-type American Blower fan, a 5-hp. G.E. driving a Deming 6 x 10-in. piston mine pump, and a Westinghouse 10-hp. motor driving another pump of the same type and size. Flat belts are used on both pumps, but new Browning V-belts and pulleys were purchased for the plant motors. All stationary motors inside the mine and out have new Westinghouse Class 7010 inclosed starting rheostats.

Mine track gage is 36 in. There are 70 mine cars in use. Forty of these were built at the mine last year, using new irons and reconditioned trucks. All but ten of the 70 cars have anti-friction bearings. Average car loading is 1½ tons. Used 25-lb. rail is laid throughout the mine, but frogs and switches were purchased new from West Virginia Rail Co. Trolley wire, size No. 4/0, also purchased new, is fitted with new Electric Railway Equipment Co. frogs, clamps and hangers. A 1940 addition is a new Fairbanks-Morse truck scale replacing the used scale originally installed. The new scale has a capacity of 33,000 lb. and a 9 x 22-ft. platform. The old scale had as large a platform, but its capacity was only 12,000 lb.



Minus 2½-in. coal is rescreened to three sizes by this double-deck vibrator.

In winter, the usual size for lump is plus 2½-in. and no large egg is made. In summer, both 6-in. lump and 2½ x 6-in. egg are prepared. The tipple is without storage for those two sizes. During the slack spring months, plus 6-in. lump is stored on the ground by dump trucks backing up a ramp of planks laid on top of the coal pile. This coal is reclaimed by hand loading into trucks; most of this reclaiming takes place during the busy months of September and October. This year, approximately 3,000 tons will be stored at the mine. The loss with this ground storage is 4 per cent. Minus 2½-in., which is carried by flight conveyor from the main shaker to a rescreening plant, is screened into small egg (2½ x ⅞-in.), stoker (⅞ x ¼-in.) and dust (minus ¼-in.). A 50-ton bin is provided for each of these three sizes. For the most part, the minus ¼-in. dust is wasted.

Seven 1½-ton motor trucks are operated by the coal company to haul part of the output to Hitchens, seven miles distant. Some of this coal is used by the General Refractories plant there and the rest is loaded into railway cars from the trucks by means of a ramp. The General Refractories Co. takes 2½ x 6-in. lump for firing the kilns and some of the smaller sizes for use under hand-fired boilers. Part of the coal shipped by rail from Hitchens goes to another plant of the General Refractories Co. at Olive Hill, Ky.

Five Trucks Are New

Five of the motor trucks now in use were purchased new. When the mine was opened in 1935, one Dodge 1½-ton truck constituted the "fleet." Following the purchase and use of a few other second-hand trucks, the purchase of new equipment was started in 1937. The fleet now in use consists of two 1936 and two 1940 Ford V-8's and three 1940 Chevrolets.

Cash-and-carry coal from the mine finds its principal markets over an area of Kentucky west to Lexington (100 miles) and northwest to Maysville (80 miles). Considerable coal also goes into Ohio, some reaching Cincinnati, Springfield and Columbus. Trucks that are returning from a freight haul from north to south sometimes carry coal back as far north as Fort Wayne, Ind.

The mine works one shift, during which time all operations, including cutting, are done. For 16 hours of the day the power plant is shut down and the fires are banked. Normal output is 300 tons per shift, but, as previously mentioned, it has reached 460 tons during periods of peak demand. Total number of employees, including office, power plant, trucking and supervision, is 90. Mr. Stephens directs the company. One son, Lester Stephens, is works superintendent, and another, Kenneth Stephens, is assistant works superintendent. William Thomas is mine foreman.

HOW TO SELECT

Carbon Brushes to Withstand Shocks Encountered in Coal-Mine Locomotive Service

By C. W. LANGE
D. C. Armored Motor Engineering Dept. General Electric Co., Erie, Pa.

BECAUSE of the mechanical shocks to which mining locomotives are subjected, the brushes on such motors must be able to withstand extremely severe vibration and shocks. If the bearings are badly worn, an additional source of vibration is produced. Good brush performance and long commutator life therefore demand that the rail joints, gear-center distance, gearing, and bearings be kept in good condition. This also is true of the commutator; if the armature is removed from the motor to turn the commutator, the shaft centers should be in good condition to insure a concentric and true commutator surface.

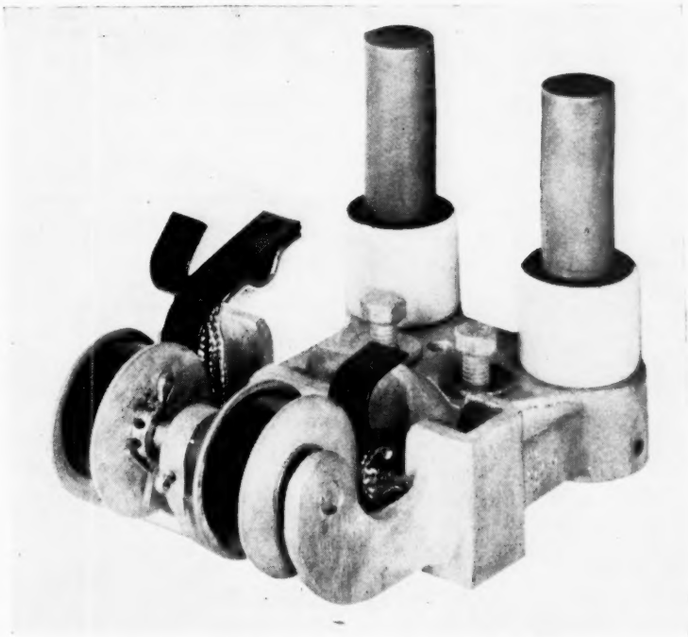
Motors for mining locomotives have been subjected to a continuous evolutionary process of improvement in electrical and mechanical characteristics. The inherent commutating ability of such motors, especially commutating-pole motors, has been improved by particular attention to this characteristic in the designing and testing of the motors. Parallel improvement, leading to better brush performance and resulting longer commutator life, has led to better grades of carbon brushes.

Successful carbon brushes have a dual nature. Mechanically, they must possess the quality of a good bearing material in contact with the rotating surface of the commutator; electrically, they must conduct the current to and from the commutator and at the same time possess sufficient contact and cross resistance to assist in controlling the rate of change of current in the armature coils undergoing commutation while they are short-circuited by the brushes.

In certain applications and on certain motors it is possible to use various grades of brushes successfully. Sometimes, however, certain grades of brushes which perform well in one case do not perform as well in other cases, and a different grade of brush is required. In easy applications an inexpensive grade may be entirely satisfactory, whereas in difficult applications a more costly and better brush will show the greatest economy from the standpoint of brush and commutator maintenance. It is almost axiomatic that long brush life and long commutator life are not found where the condition of the commutator is bad.

One means of insuring the maintenance of good commutator condition, provided, of course, the commutator remains tight and is not accidentally damaged, is the use of a grade of brush which will meet the requirements of both satisfactory commutation and satisfactory brush life. This is a simple statement of the case, but the actual selection may not always be so simple. To obtain the best commutation and the longest commutator life, it may be necessary to use a grade of brush which has a somewhat shorter life than a poorer grade.

In some cases where the commutator surface cannot be kept clean because of atmospheric contamination by gases, fumes, or dirt, or operating conditions which cause an excessive carbon deposit or smudge on the commutator surface, or a certain amount of sparking caused by heavy overloads, brushes with a small degree of abrasiveness may be used. A brush sufficiently abrasive to keep the commutator clean necessarily means some additional wear of the commutator and brushes. Consequently, it is always

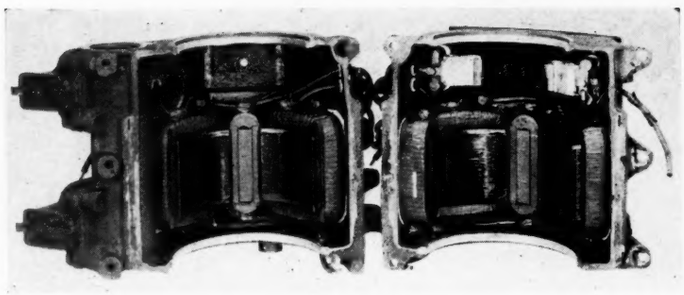


Brush holder for d.c. transportation motor.

preferable to use non-abrasive brushes which require undercutting of the commutator mica segments if it is possible thereby to obtain the desired results.

Sometimes, although somewhat infrequently, it is not possible to adjust the commutating field of a motor to get the best results with a certain grade of brush. It is then necessary to rely in part on the inherent commutating ability of the brushes, and to select a different grade. One of the biggest factors in determining the commutating ability of a brush is its ability to ride the commutator smoothly; that is, to maintain intimate contact by absorbing shocks because of its elasticity. Brushes with a sufficient degree of elasticity to meet this requirement may have a slightly porous structure and a somewhat shorter life than a denser brush.

The principal characteristics usually considered in a brush are the resistance, density, and hardness, each of which affects commutation, and the ability of the brush to ride smoothly on the commutator. These characteristics in themselves, however, do not determine positively the inherent ability of a brush to perform satisfactorily. Also, different brushes which are the same as regards these characteristics may not perform the same in actual operation. Conditions external to the brush, such as temperature, humidity, gases or dust in the atmosphere, have a considerable effect on brush performance. The kind of film on the commutator also is an influencing factor. For a good performance a very thin film is desirable.



Magnet frame for locomotive motor.

Sparking, when it occurs, generally is more pronounced at the positive brushes. A slight degree of humidity improves the riding quality of brushes somewhat, but excessive humidity such as is often encountered with mining-locomotive motors may produce an injurious electrolytic action on the commutator. It is well, therefore, to see that water is not allowed to collect in the motors.

HOW PHOTOELASTICS

Pictures Mine-Structure Stresses

By Use of Small-Scale Transparent Models

By PHILIP B. BUCKY
Associate Professor of Mining
School of Mines, Columbia University

MINE executives readily appreciate the effects of taxes, wages and mechanization on costs, safety and profits. One factor which, in most cases, has a greater effect on these items than any previously mentioned is physical stress. It has not been fully appreciated in the past and is not fully understood at present. It is generally due to a load or weight of some kind acting on mine props, pillars, roofs or bottoms. Stress causes breaking of props and roofs, heaving bottoms, increase in accident rate, pillar failure, the rock bursts with which so many deep mines must contend, and high maintenance costs, which ordinarily are present in at least one section of every mine. Adoption of procedures which make it possible to determine what the stresses are in all parts of a mine, plus a knowledge of the ability of the structural material there to stand up under them, inevitably mean safer and more economical mining.

When a body—i.e., a mine structure or portion thereof—is not stressed, it will not fail, will not require support to keep it in position and can, therefore, do no damage to any person or piece of equipment near it. The importance of stress and its effects on costs and safety may readily be determined by comparing records in sections where evidence of high stress is present in all workings, openings and solid portions of a mine. Proper understanding and handling of stress will pay dividends as great as the ability to coordinate labor and machines. Indeed, efficient and safe working of labor and machines depends to a great extent upon the proper handling of the stresses involved in any mine.

Materials stressed within their elastic limits, as the mining engineer knows, will stand for long periods. Steel, concrete and wood have certain strengths, in pounds per square inch,

in tension, compression, and shear. Steel has elastic limits of strength that wood and concrete do not have. The elastic theory, as the engineer learned it, does not apply perfectly to wood or concrete, but the use of a safety factor and a knowledge of the properties of these materials make it possible to design safe structures of these materials which stand for long periods of time.

A mining engineer's knowledge of geologic materials is primarily concerned with mineral content, chemical characteristics, crystal structure, hardness, and its age as determined by fossils or sequence. Little time was spent determining the strengths of these materials, and the physical properties determining their behavior as part of a mine structure. Yet on these properties depend his life, the safety of his workmen, his ability to mechanize, and the percentages of minerals extraction.

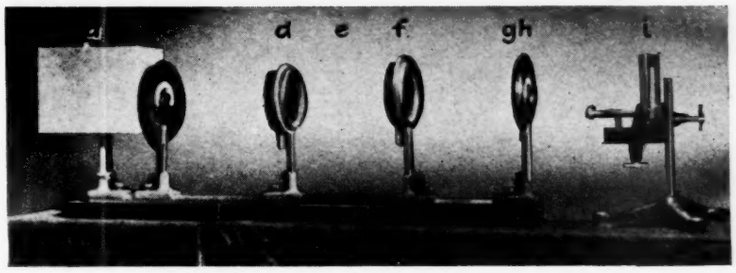
Other engineers dealing with a few well-controlled materials, such as steel, concrete and wood, have built significant data concerning the structural properties of those materials. Literature on these subjects is voluminous and the net result of this knowledge is evident to the eye in the great building structures of all localities. While it is true that these problems dealt only with structures stressed within the elastic limits, it is also true that a great many mining structures or parts thereof should be so designed.

If one substitutes "structures designed to stand for long periods of time" for "structures designed within the elastic limits" it will be realized that many mining problems come within this category. In all mines some portions, such as shafts and shaft pillars, must have a comparatively long life. Others—e.g., gangways, levels, etc.—may have a shorter life, while still others, such as stopes, breasts, rooms, etc., may have a comparatively short life. The surface in some cases need be given little consideration except for surface plant protection. In others whose workings underlie cities, like Scranton, Wilkes-Barre and Hazleton in the anthracite fields, and certain portions of the bituminous fields in Illinois, the problem becomes an important one from the standpoint of recoverable coal, possible property damage, and economic procedures in mining.

In all steeply dipping deposits, the proper placing of gangways or haulage drifts in relation to stopes or breasts has an enormous effect on both maintenance costs and safety. The same may also be said for the placing of chutes and transfer levels in massive deposits mined by caving or slicing methods.

It thus becomes apparent that in determining the procedure for mining the important factors are: (1) which portions may be designed to fail immediately, (2) which shall fail after a given period of time, and (3) which portions must be designed to stand for long periods of time. While the general method described in a previous article may be applied to the solution of all these problems,[1] the method of stress analyses to be described, called the photoelastic method, is applicable only to structures stressed within the elastic limits, viz.: (3) those designed to stand for long periods of time.

Since the theory of elasticity informs us that all materials stressed within their own elastic limits[2] behave the same, a given load on glass, Bakelite, concrete, steel or sandstone



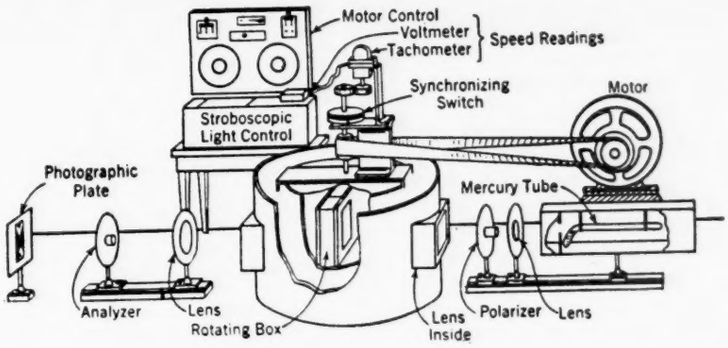
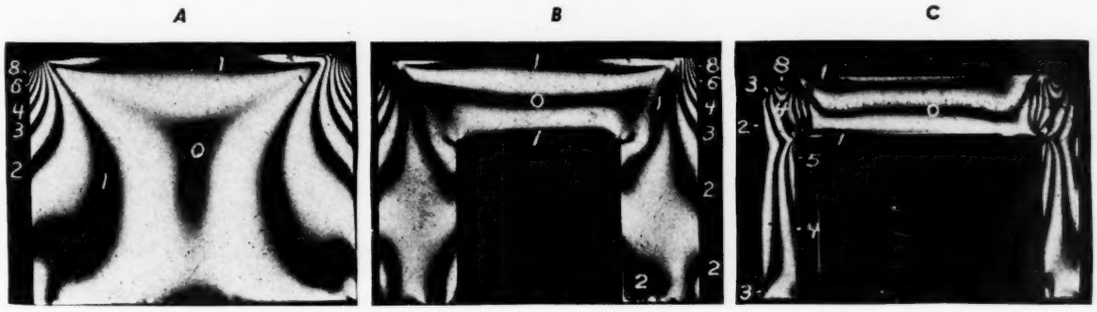


Fig. 1—A (top), Photoelastic apparatus for determining P-Q and principal stress directions: *a*, source; *b*, polarizer; *c*, quarter-wave plate; *d*, lens; *e*, space for model; *f*, lens; *g*, quarter-wave plate; *h*, analyzer; *i*, screen. B (below), diagrammatic representation of combined centrifugal and photoelastic equipment used for centrifugal loading (from *Civil Engineering*).

[1] *Coal Age*, July, 1940, p. 40.

[2] Elastic Limit: The maximum unit stress to which a bar of the given material may be put without that bar losing its ability to reassume its original dimensions when the stress is released.



2—Shear stresses in solid and mined pillars.

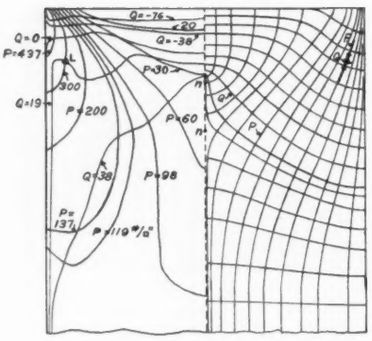


Fig. 3—Principal stresses in pillar: left, stress contours; right, directions.

beams of the same dimensions will cause the same stresses and stress distributions in all of them. However, a transparent glass, celluloid or Bakelite beam when stressed and placed between certain apparatus, Fig. 1*A* and *B*, through which polarized light (light vibrating in one direction) is passed causes refractions to appear in direct relation to the magnitude of the stresses, their distribution, and their actional directions. Therefore a model of transparent material may be used to determine what the stress and direction of action are at all points in structures of non-transparent materials such as concrete, wood, steel, sandstone, etc., provided they are not stressed beyond the elastic limits and the refraction pattern pictures are interpreted correctly. For most mining work, models should be loaded as in the field in a centrifuge. The combined centrifugal photoelastic and photoelastic equipment[3] is shown in Fig. 1*B*.

An example of the visible stress effects obtained when placing a loaded Bakelite pillar in the photoelastic apparatus is shown in Fig. 2 (*A-C*). Each numbered dark area is a fringe or contour area of shear stress. The value of each band, found in Table I by experiment, having been determined at approximately 78 lb. per square inch more or less than the previous one, indicates that over most of the pillar the stress is 1x78, or 78 lb. per square inch, while at the corners the stress is 8x78, or 624 lb. per square inch (Fig. 2*A*). If the material in the mine will stand a stress of 3,120 lb. per square inch, the pillar will not fail in any part, as the safety factor is 3120÷624, or 5.

Fig. 3 is constructed from a series of pictures which were taken of the solid pillar (Fig. 2*A*) and shows the value of the principal stress contours, called *P* and *Q*, and their directions at all points in the pillar. For example, at point *L*, on the left, the *P* stress is 300 lb. per square inch and the *Q* stress is 19 lb. per square inch, acting in the direction of the heavy arrows at the corresponding point shown on the right.

It is evident, therefore, that a means is available for determining the stresses at all points in a pillar, which may be represented by a photoelastic model. If the strength of the material is known, conclusions may be reached as to whether the pillar will stand or fail, at what parts failure will start and whether different pillar shapes will provide better support so that certain portions of it may be mined. This is illustrated in Figs. 2*B* and *C*, from which it is noted that even with 60 per cent of the pillar mined out the maximum stress is still 624 lb. per square inch at the corners as before, while the maximum stress in the legs is only 312 lb. per square inch. If the material has a strength of 3,120 lb. per square inch, this pillar with 60 per cent mined out is just as capable of supporting the load as a solid one. Pillar dimensions and shapes to support the surface may thus be determined by these methods and the quantities of material that may be removed from old workings are reasonably estimated.

At the present time, evidences of load and stress underground are shown by the breaking of timbers, pillar spalling, pillar crushing, roof or bottom heave and roof sag. A gangway recently visited showed all of these faults with maintenance costs recorded at a minimum of $50 per foot per year. Important considerations, therefore, are the location of haulageways and openings in relation to pillars, working and worked-out areas. Will these openings stand? Will they require high maintenance costs? Can these openings be placed so that maintenance costs will be low and maximum safety attained? These questions vitally concern all operations working steeply inclined deposits by any method and massive deposits by caving or slicing methods.

This field has scarcely been explored and that this method may prove of value is shown by the following: Fig. 4 (*A-D*) illustrates the visible stress effects that occur in a Bakelite model of a tunnel and the intervening strata between it, the pillar directly above it and the stope floor. Fig. 5 shows the principal stress values and directions at all points, and Table II gives the stress values at four important points in the tunnel. It is interesting to note from Fig. 5 that

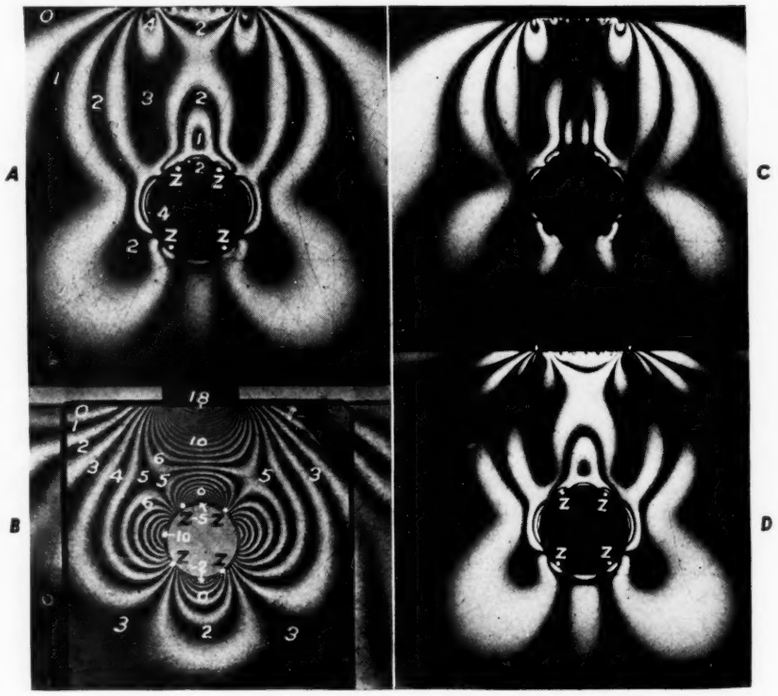


Fig. 4—Visible stress effects around tunnel directly below pillar: upper left, isochromatics; lower left, isopachics; upper and lower right, isoclinics. (For effect with tunnel to one side see Fig. 6.)

[3] For complete description of apparatus and procedure see A.I.M.E. T.P. 1140, "Photoelasticity and Its Application to Mine Pillar and Tunnel Problems."

Table I—Fringe Values

Fringe No.	Value in pounds per sq. in.
1	78
2	156
3	234
4	312
5	390
6	468
7	546
8	624
...	...
10	780

at the four points in the tunnel marked *Z* the stress is *O*, and from Table II and Fig. 5 that at points 2 and 4 there is a compressive stress (shown by +) and that at points 1 and 3 there is a tensile stress (shown by −). The effects caused by placing the tunnel at one side of the pillar are quite marked, as shown in Fig. 6.

It thus becomes evident that barodynamic methods must include two types of models for study in centrifugal fields:

1. Models of the same material as the prototype, to determine how a structure will behave through to failure, and the time effects. This includes problems relating to block caving, stope, or room and pillar methods where support of the surface is not particularly essential, and problems concerned with heaving bottom and plastic materials.

2. Models of photoelastic materials, as glass, Bakelite or celluloid, to determine pillar shapes, spans, level and drift or gangway locations, in cases where openings are to stand for a considerable time or the surface is to be permanently supported.

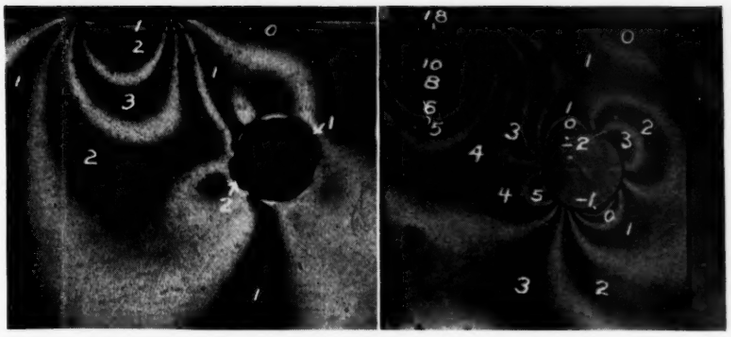


Fig. 6—Visible stress effects around tunnel or gangway placed to one side of pillar (compare with Fig. 4).

The development of these principles and procedures considerably enlarges the field of the mining engineer. It makes laboratory tests and studies as important an adjunct of a mine as a preparation plant, and brings home the fact that there are innumerable possibilities in the mining field for reductions of costs and an increase in safety factors.

At present the time lapse between pure and applied science—i.e., engineering—is being shortened, and a greater appreciation of the value and importance of pure science is now making itself felt.

Our understanding of the behavior of geologic structures in mines is definitely linked with Newton's law of gravitation and the principles of mechanics and similitude which he reached from the basis of observations of the motion of the moon.

Hooke's law, Young's modulus, and Poisson's ratio, about 1678, all of which relate to the behavior of materials stressed within elastic limits, and Newton gave us the basis for our knowledge of strength of materials.

When Brewster in 1816 discovered the phenomena of double fraction in certain materials, that, plus previous knowledge, gave us the basis of our present photoelastics, whereby pictures are obtained to show the stresses at all points in a structure and how they act.

Realization of the importance of stress knowledge in the design of all structural or machine parts under load has increased tremendously since 1920. Because photoelastic procedures give others information previously unattainable, photoelastics' growth has been phenomenal in that period.

One need visit only a few properties and check those portions where maintenance costs are high in order to see the possibilities and applicabilities of photoelastics.

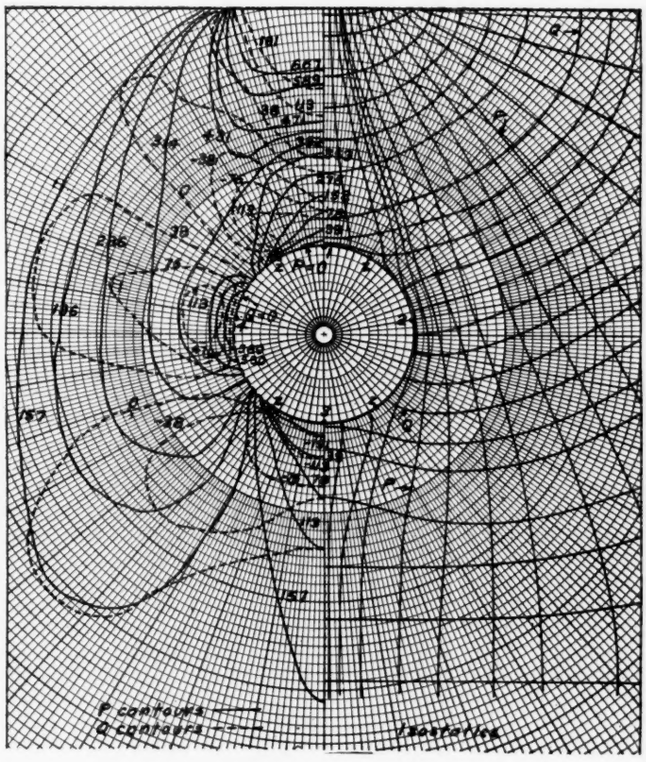


Fig. 5—Principal stresses around tunnel.

Table II—Observed and Calculated Tunnel Boundary Stresses at Points 1, 2, 3, 4, Fig. 5.

Point	ψ	θ	Average Observed S, Lb. per Sq. In.	Calculated S, Lb. per Sq. In.
1.....	90 deg.	42 deg.	−307 tension	−283 tension
2, 4.....	0 deg., 180 deg.	30 deg.	728 comp.	712 comp.
3.....	−90 deg.	25 deg.	−224 tension	−192 tension

NEW LIGHT ON OLD QUESTIONS

What Safety Inspectors at Anthracite Mines Should Look For During Their Visits*

By C. A. PETERSON

Safety Inspector, Hudson Coal Co., Scranton, Pa.

Inspections by section foreman, foreman or safety inspector will be successful only if definitive objectives are laid down and constantly reviewed and will not be the reward of a brilliant improvisation. The official must know just what he must look for and be on his mettle to note whether what he wants is being done. Proper working habits are the long-range purpose of the inspector or boss. Safe conditions may come and go, but the safe worker is a permanent asset.

"YOU SEE only what you look for" is a time-worn adage readily verified by personal experience. The hazards encountered in mining are so numerous and varied that unless they are systematically tabulated and frequently reviewed by safety inspectors and foremen, many dangers will slip into the background of consciousness until they are suddenly and sadly brought to attention by a fatal or serious injury.

The Hudson Coal Co. has found it advantageous to keep its safety inspectors and foremen constantly in mind of injury hazards for which they should be looking. This has been done by three means: (1) a printed list of 210 of the more common hazards which inspectors and foremen can read from time to time as a reminder; (2) a monthly letter briefly describing each fatal or serious injury which has occurred on the property during the preceding month; (3) bulletins based on the company's current injury experience, issued at frequent intervals by the Safety Key Men's Organization, which is composed of officials who have achieved outstanding safety records. Each section foreman is required to read and explain these bulletins to the employees under his jurisdiction.

Correct Unsafe Attitudes

Detection of physical hazards and unsafe practices is the urgent and inescapable short-term problem of the safety inspector. The long-term problem is that of discovering and correcting unsafe mental attitudes and habits.

Special attention should be given by the safety inspector to those hazards which may cause the loss of several lives at one time. Fortunately, the frequency of such disasters has been decreasing, but therein lies their greatest danger, for their infrequency may lull us into a false sense of security.

Hazards of this type are large unsupported open areas in pillar mining which may cause sudden extensive squeezes or falls, failure to replace timber in crushed ground, accumulations of methane due to geological structure, faulty mining methods or neglect of ventilation, bodies of water standing at elevations higher than the active workings, travel of groups of men on slopes or planes, improper handling of explosives, mine fires, and inadequate second openings.

In looking for hazards of less than disaster magnitude, the safety inspector well can be guided by mine-accident statistics. Roof falls cause, roughly, one-half of all fatalities. It would be well if the inspector devoted a little more than half his time and effort to these hazards, for, despite the large proportion of accidents from this cause, no type of accident is more often inexcusable or more readily preventable.

Many section foremen have supervised mining over long periods of time in areas where the roof was very bad and yet have had few roof-fall injuries, which proves that such accidents largely can be eliminated. Investigations of such injuries lead inevitably to the same conclusion. Safety inspections furnish evidence of a general tendency to neglect thorough and systematic examination of roof and even more generally of ribs and faces.

Roof-fall hazards in the Northern Anthracite Field are extremely varied; there are the usual hazards from slips and saddles, from overhangs, from a thin weak stratum directly over the coal bed, and from neglect of props and timbering. They are common to both chamber and pillar mining.

Second-Mining Hazards

Much of the coal now obtained comes from the skipping of pillars in crushed or caved ground. When a pillar is being skipped, a definite danger zone is created along the original rib line of the pillar, because the roof at that point has been weakened by fracture and also by exposure to air and moisture. The safety inspector therefore should note if, when the roof is tested, this zone receives special support and attention.

The roof of beds 9 ft. to 16 ft. thick, or thicker, presents an extremely serious hazard because the height from floor to roof makes inspection, trimming, timbering and propping unusually difficult. In high working places, roof-fall injuries occur more frequently than might be expected from the tonnage obtained from such workings. The safety inspector should observe if the necessary effort is made to inspect, trim and secure such roof, and whether necessary facilities such as planks and horses are provided for so doing.

In many roof-fall injuries, changes in roof conditions as a working place advances are important factors. The safety inspector should note whether, when conditions vary, the miner revises his timbering and mining practice to meet the change.

In some cases, in the Northern Anthracite Field, as many as fifteen different beds of coal are being worked at one time at a single colliery. Safety requires that the pillar-robbing face in any given bed be kept a sufficient distance in advance of that in the underlying bed. The safety inspector must familiarize himself with the nature and thickness of the rock strata separating the beds of coal so that he can evaluate correctly the roof conditions found at the working faces.

Dangers on Steep Pitches

Mining on a heavy pitch is frequently associated with injuries from falls of roof and coal, as well as injuries from falls of person. In such places, roof, ribs and face must be trimmed thoroughly; props must be set close to the face so as not to be dislodged by falling material; sufficient loose coal must be kept close enough to the face to afford the miner a secure footing and a safe position when trimming down loose material, and also when doing his other work.

Manway steps must be of sufficient strength and not too far apart. The top of the manway must be protected from falling material; proper safeguards must be used to prevent men from falling into chutes; and on extreme pitches a manway must be provided on each side of the place.

Transportation continues to be the second most serious source of injury. Defective rolling stock and tracks, insufficient clearance, and neglect of sensible and well-known safety rules are hazards to be noted and corrected.

Conveyor loading has largely eliminated the hazards incident to the handling of cars on heavy gradients in chambers, but the spotting of cars at conveyor-discharge points on the gangway has taken its place as a prolific cause of transportation accidents. For-

* Abstract of an address presented at National Safety Congress, Mining Section, Oct. 8.

tunately, whether cars are spotted manually with the aid of snubs or mechanically by means of a car-spotting hoist, little skill or agility is needed for that purpose on the comparatively gentle gradients usually found on gangways.

Hazards which cause such accidents are: inadequate clearance and dirty track at car-loading point, insufficient blocking of loaded and empty cars, improvised snubs which needlessly expose fingers to the danger of being pinched, starting to load car too close to its end, thus causing it to tip while being loaded, and hazards associated with car-spotter hoists, such as worn rope, unsafe mechanical conditions, and switch so located that the man who has to throw it cannot remain at a safe distance from moving cars when doing so. In the few cases where heavy gradients are found on the gangway at the discharge point of the conveyor, it is necessary to make sure that the man spotting cars can do the work safely or that a mechanical car spotter is provided that will permit the work to be done without hazard.

Use of electric cap lamps largely has eliminated ignition of methane as a cause of accident. However, the feeling of safety inspired by electric cap lamps in some cases may lead to neglect of brattices, flame safety lamps, doors and ventilation generally, and the safety inspectors must be on the lookout for evidence of such neglect.

Batteries Should Be Dated

Widespread use of electric detonators and igniters has made blasting safer, but even when coal shots are thus ignited, ignorance and carelessness continue to cause injuries. The most important things to note are condition of blasting battery, especially the last date on which it was tested by the mine electrician, condition of firing line (noting whether joints are tightly twisted and staggered, also whether pieces of wire so short that they should be discarded are incorporated in the line), location of firing station, whether blasting battery is kept under lock and key at all times except when actually in use, and whether ends of firing line are kept twisted together and thus short-circuited.

When there is no opportunity to observe a miner's blasting practices he should be questioned about them, the inquiries being directed to ascertain his method of stretching his firing line, whether signal lines are removed from face and all electric power is cut off before beginning to charge holes, his method of handling misfires, and of giving warning to others. The latter is especially important when working places are approaching each other or the place is about to tap through into an opening.

A safety inspector naturally can detect physical hazards more readily than unsafe practices, yet the latter cause so many injuries that they merit particular attention. Unsafe practices are exhibited in every step in the mining process: blasting, loading, timbering, transportation, etc., but they are so numerous that they cannot be enumerated here. The safety inspector should observe closely every act of any man with whom he comes in contact, particularly noting what that man is doing when he first sees him.

Although many unsafe practices are difficult to detect, one he can scarcely overlook and that is failure to wear suitable protecting clothing: skullguards, goggles, respirators, gloves, kneepads (in low places), and hard-toed shoes. It is important too to note their condition. We frequently hear of casualties prevented by wearing hard hats, but men have been injured when wearing broken hats which failed to give protection.

Other references to the quest for safety may be found in the report on the meeting of the National Safety Council at Chicago, p. 72. An article explaining the importance of adequate grounding of equipment to prevent serious stray currents with their hazards to life, p. 44, is another contribution to the needs of underground officials.

In recent years, increase in mechanical mining has brought with it many new problems in safety. Although, in general, mechanical mining inherently has possibilities of greater safety than the methods which it supersedes, such increased safety will not be obtained without vigilance by those charged with the safety of operations.

Some of the most important hazards in mechanical mining for which the safety inspector must look are: insufficient clearance around machines, inadequate guarding of moving parts, defective or inadequate signaling apparatus, insecurely anchored pulleys and jacks, apparatus not maintained in safe mechanical condition, worn ropes on undercutters and other equipment, failure to place guard on undercutter chain when the machine is not cutting, delay in the setting of props or timber to facilitate loading with certain types of apparatus; improper fusing, insulation, grounding and splicing on electrical installations; and the handling of heavy or cumbersome parts in an unsafe manner when installing or removing equipment.

Slip, Trip or Collide

On travelingways the safety inspector should look for slippery or icy places, obstacles over which a man might trip or into which he might bump, also for roof and timber hazards.

In working places that are approaching bodies of water, the safety inspector should note whether State mine laws regarding width of place and boreholes drilled in advance and on the flanks are being observed. He also should look for physical hazards which reflect oversight or neglect on the part of the section foreman, such as crosscuts not started at specified legal distance, and roof and rib conditions at places other than the immediate working face.

Not many years ago, one of the great obstacles to safety improvement was the type of foreman who felt that both his duty and responsibility were fully discharged if, when an employee was injured, he could say "I told him not to do that but he went ahead and did it anyhow." Fortunately, years of safety education and refusal by management to accept such excuses has largely eliminated or reformed this type of foreman.

In general, the individual section foreman today has a better safety record than in the past, but there is still a wide discrepancy between the safety records of the best and the poorest, and this discrepancy may be attributed largely to three wrong habits of supervision which readily can be discovered by the safety inspector. These are:

(1) Distraction by matters other than safety. Other matters are, of course, as essential as safety, but it is simply good business and good psychology for a section foreman visiting a working face to devote the first part of that visit to a thorough and relentless search for injury hazards, to make his last words before leaving the place an admonition concerning safety and to take up other matters in the intermediate part of his visit.

(2) Failure to place enough emphasis on safety training of his men. Safety training should be a constant process. Even such a simple device as the habit on the part of the sectional foreman of asking a miner how he expects to do the rest of his day's work is helpful. In answering the question, the miner naturally thinks of safe ways to do his work and the chances of safe work being done are much better than if the question were not asked.

(3) Disposition to compromise on discipline, the most serious habit of all. When mercy or the desire for production, as the case may be, seasons justice, the stew often becomes all seasoning and no justice.

Correction of the foregoing habits, of course, is largely up to the section foreman's immediate superiors. However, if the safety inspector is observant of such faults, the section foreman quickly becomes aware of the fact, with good effect.

Finally, the safety inspector should now and then take inventory of himself, try to discern his own faults and failures and overcome them. He should ask himself: "Am I becoming merely a routine recorder and reporter of physical hazards? Do I study the men I meet and look for opportunities to leave a worth-while safety thought with as many as possible of them? When I look for safe ways of doing things, do I also ask myself if my way is efficient and acceptable to the workman?"

All the factors which affect safety have been changing during the past few years and are continuing to change. Predominant physical conditions have changed with the change from thicker to thinner beds, from unbroken to more and more caved and crushed ground.

Hand mining has given way to mechanical methods and the original mechanical methods have been and continue to be displaced by more efficient mechanical methods. Even the human factor is changing significantly as foreign-born are displaced by native-born.

Human Element Also Changes

The man who started to work as soon as he was big enough to carry a dinner pail is being displaced in many cases by a high school graduate, and men who were old in the industry and whose work habits had been formed before they were subjected to rigorous safety training are being displaced by young men who hear safety preached to them from the first day they enter the mines. The result is a changing picture in which new hazards and practices are arising and emphasis on old ones is constantly changing. If safety is not to lag behind other phases of our progress, the safety inspector must know not only what to look for today but also what to look for in the changed situation of tomorrow.

QUESTIONS ASKED BY STATE BOARDS

Mine Foremen's Examination, State of Iowa, June 11-12, 1940 (continued)

Ventilation

Q.—(a) If a fan is producing 100,000 cu.ft. of air per minute and the sum of your measurements near the faces of the entries show 40,000 cu.ft., would you consider the ventilation good or bad? (b) If bad, what would you do to remedy the condition?

A.—(a) Bad. Only 40,000 cu.ft. of air out of 100,000, or 40 per cent, is reaching the face. Some leakage is unavoidable. Probably, the best of mines will put 85 per cent of the air handled by the fan at the face of the workings. Seventy per cent or more should be achieved by every mine, though much will depend on the length of the air travel, on the distance between intake and return airways and on the water gage. High pressures make more active leaks.

(b) Eliminate leakage as far as practicable, both at doors and stoppings, especially at points not far from the fan where air pressures are highest. Provide intakes and returns as far apart as possible. Replace or reinforce gob stoppings with double-board brattices or, better yet, with tight stoppings of concrete, cement block or brick.

Make it easy for the air to pass through the mine and then the mine air pressure (the water gage) can be reduced, and this will reduce leakage. This can be done by straightening roads, casing sharp curves, but especially by removing fallen rock and heaved bottom from caved airways or at least breaking up the slabs of rock so that they will lie flat and take up as little space as possible. Shorten the distance the air has to travel where that can be done; this will permit of reducing water gage and usually will reduce leakage also.

Q.—What conditions are necessary to insure good ventilation in a mine producing 840 tons of coal per day?

A.—Just how many tons per man are produced, and whether animal haulage is to be used is not stated. Nor is it stated whether loading machines are used. (Examinee probably would assume a suitable tonnage per man and the examiner would be satisfied doubtless with that method.) To answer this question, let Appanoose County be taken as typical, as it is the largest coal-producing county in the State. In 1937, the production per man-day in that county was 2.39 tons, but the production per inside employee probably would figure 2.60 tons. To produce 840 tons would require, therefore, 323 inside employees, and each man would require 100 cu.ft. per minute, or in all 32,300 cu.ft. of air per minute. Assuming that mules or horses haul the coal and that each animal hauls 30 tons per day, 28 animals would be required and, allowing 500 cu.ft. per minute for each animal, 14,000 cu.ft. of air per minute would be required for their operations.

Thus, the law requires that 46,300 cu.ft. of air be furnished. But, as is indicated in the earlier question, only 40 per cent may go to the face. Let 50 per cent be assumed to be so distributed, then the fan must supply 92,600 cu.ft. of air per minute or, say, 100,000 cu.ft.

Water gage will depend on the distance the air has to travel. Ventilating speed should not exceed 1,000 ft. per minute for a distance of 2,000 ft. from the mine opening, so the cross-section should be 100,000÷1,000, or 100 sq.ft., but this velocity is not a legal, but an economic, requirement. It is evident, however, that it is desirable that there should be two intakes and two returns each measuring about 6x8 ft. or 6x10 ft. in cross-section or the equivalent. In most cases, the distance will exceed 2,000 ft. and the speed of the air should be reduced if it is to travel that greater distance, but enough leakage already has been assumed to make the velocity permissible. Most mines have inadequate airways, which is why a complaint is so general about a deficiency of air.

Mining Laws

Q.—(a) What maps should be kept at mine? (b) What data should be shown thereon and how often should an extension be made on these maps? (c) If the scale is 200 ft. per inch and the main entries on the map measure 6 ft., what would be their actual length?

A.—(a) Under the mine laws of Iowa, maps of the workings in each seam must be made for every mine and, where the surface buildings, lines or objects are so numerous as to obscure the details of the mine workings, if drawn on the same sheet with them, a surface map must be made on transparent cloth or paper so that it can be laid upon the map of the underground workings and thus truly indicate the local relation of lines and objects on the surface to the excavation and any other principal workings of the mine.

(b) Name of State, county and town in which mine is located, designation of mine, name of company or operator, certificate of mining engineer or surveyor, as to accuracy and date of survey, north point and scale to which map is drawn, surface boundary lines of coal rights pertaining to each mine, all section or quarter section lines or corners within same, lines of town lots and streets, tracks and sidewalks [*sic*] of all railroads, locations of all wagon roads, rivers, streams and ponds, reservations made of coal or mineral, shafts, slopes, tunnels and other openings to surface or to workings of a contiguous mine, all excavations, entries; rooms and crosscuts, escapeways; fan, furnace or other means of ventilation, direction of air currents, location of pumps, haulage engines, engine planes, abandoned works, fire walls and standing water.

Each map of underground workings must also delineate, by profile drawing and measurement, the last 150 ft. approaching boundary lines showing rise and dip of seam. In making the map, no more than 200 ft. shall be represented by an inch. Extensions must be made every twelve months and prior to July 1 of each year, so long as the mine is in active operation.

(c) As 6 ft. is 72 in., and as each inch represents 200 ft., 6 ft. on the map will represent 14,400 ft.

(*These answers are unofficial*)

First Grade Mine Foremen's Examination—Pennsylvania, April 4, 1939

Answers to these questions are those furnished to the examiners. A maximum allowance of 20 per cent is made for experience.

Mine Gases

P.—(a) Name the principal combustible gas usually found in coal mines. Name the other combustible gases which may be found in a coal mine. Give symbols and specific gravity of each. (b) State briefly where and under what condition the combustible gases are found. (c) How would you detect them? (d) Effect on life and combustion? (e) To what extent must oxygen be reduced before an explosion of methane is impossible? (f) Can a canary be used to indicate a dangerous oxygen deficiency?

A.—(a) Methane, sometimes called marsh gas or light carbureted hydrogen gas, is the principal gas liberated from coal beds. (2 per cent.)

Other combustible gases which may be found are: carbon monoxide, hydrogen, hydrogen sulphide.

Gas	Symbol	Specific Gravity
Methane	CH_4	0.559
Carbon monoxide	CO	0.972
Hydrogen	H	0.069
Hydrogen sulphide	H_2S	1.1912

(b) Methane possibly found anywhere in the mine, but most probably in new workings where gas has not been drained off; also in the rise workings, high places, crev-

ices, cavities, and poorly ventilated places.

Carbon monoxide is generally found in areas affected by fires and explosions.

Occurrence of free hydrogen in mines is very rare. It is found in afterdamp of some mine explosions, particularly when firedamp mixture contains more than 9½ per cent of marsh gas.

Hydrogen sulphide is found in the vicinity of stagnant water where ventilation is bad, in old pipe lines, pumps, and in fire areas. (2 per cent.)

(c) Methane is detected by the flame of an approved safety lamp, and by the approved methane indicator.

Carbon monoxide is detected by an approved carbon-monoxide detector, canaries or mice.

Hydrogen is detected by the same methods as methane.

Hydrogen sulphide is detected by an odor resembling that of rotten eggs or by use of a hydrogen-sulphide detector. (2 per cent.)

(d) Methane will not support life. When in excess quantities will suffocate by excluding oxygen from the lungs. It is combustible but will not support combustion.

Carbon monoxide is dangerous in small quantities—0.1 to 0.2 per cent. When breathed into lungs, it absorbs oxygen from blood, thus destroying life and health. It is combustible but will not support combustion.

Hydrogen, the same as methane.

Hydrogen sulphide is extremely poisonous. When breathed in small quantities, it deranges the system, and in larger proportions it produces unconsciousness, prostration and death. It is combustible but will not support combustion. (2 per cent.)

(e) 12.1 per cent. (1 per cent.)

(f) No. The canary will live in as little or less oxygen than a man. (1 per cent.)

Chief Mine Electricians' Examination—Pennsylvania, 1939

The following questions were presented at the examination for chief mine electricians of gassy bituminous coal mines in 1939. The answers are those prepared by the committee which propounded the questions and were the basis for marking the papers. The percentage awarded for a correct reply follows each answer.

Experience is rated as 40 per cent, but full rating credit was to be given only to those candidates who were then employed as chief mine electricians or to those who had extensive experience in that capacity. An oral examination to ascertain the competency of the candidate to handle and use an approved safety lamp and to determine the presence or absence of explosive gas accompanied this written examination.

Electrical Definitions

Q.—Define the terms "potential" and "voltage"; also the term "difference of potential."

A.—The terms "potential" and "voltage" are synonymous and mean electrical pressure. The term "difference of potential" means the difference of electrical pressure existing between any two points of an electrical system, or between any point of such a system and the earth, as determined by a voltmeter. (1 per cent.)

Q.—What is meant by a "voltage drop" in transmitting electric current?

A.—Voltage drop in the transmission of electric current means a decrease in electrical pressure due to ohmic resistance of electrical conductors. (1 per cent.)

Q.—What is a volt; an ampere; a watt; and an ohm?

A.—A volt is a unit of electrical pressure: an ampere is a unit of flow of electrical current; a watt is a unit of work; an ohm is a unit of resistance. (1 per cent.)

Q.—How are (a) a "low-voltage supply," (b) a "medium-voltage supply," and (c) a "high-voltage supply" defined in the Pennsylvania Bituminous Mining Law?

A.—(a) When the supply of electricity is such that the difference of potential between any two points of the circuit cannot exceed 300 volts. (1 per cent.)

(b) When the supply of electricity is such that the difference of potential between any two points in the circuit may at any time exceed 300 volts but cannot exceed 650 volts. (1 per cent.)

(c) When the supply of electricity is such that the difference of potential between any two points in the circuit may at any time exceed 650 volts. (1 per cent.)

Grounding and Insulation

Q.—(a) When is any part of an electric system properly grounded? (b) What electrical equipment must be effectively grounded?

A.—(a) When any part of an electric system is so connected to the earth that there will be no difference of potential between them. (2 per cent.)

(b) All metallic coverings, metal armoring of cables, and the frames and bedplates of generators, transformers, and motors; also the neutral wire of three-wire continuous-current systems. (2 per cent.)

Q.—Are underground systems that are completely insulated from earth required to be equipped with a properly installed ground detector?

A.—Yes. (1 per cent.)

Explosionproof Units

Q.—What are explosion- or flameproof casings or inclosures as defined in the Bituminous Mining Law?

A.—Explosion- or flameproof casings or inclosures are those which, when completely filled with a mixture of methane and air, and the latter two gases exploded, are capable of either entirely confining the products of such explosion within the casing or of so discharging them from the casing that they cannot ignite a mixture of methane and air, combined in proportions most sensitive to ignition and entirely surrounding the points of discharge, and in most intimate proximity therewith. (4 per cent.)

Q.—In gassy portions of mines in which explosionproof equipment or permissible equipment is used, who is to open such equipment and what must be done about the power before such equipment is opened?

A.—Such inclosures shall not be opened except by an authorized person, and then only when the power is switched off. The power shall not be switched on while such inclosures are open. (2 per cent.)

Q.—Why are cables entering explosionproof electrical inclosures passed through stuffing boxes?

A.—To prevent the admission of explosive gases to the inclosure, and also to prevent the escape of flame that might be produced inside the inclosure. (3 per cent.)

Q.—(a) Describe an effective flange joint in an explosionproof casing. (b) What precautions would you take to assure the effective maintenance of such a joint? (c) How would you determine the effectiveness of a flange joint?

A.—(a) A metal-to-metal contact of flat machined surfaces of proper width flanges, which are kept clean and free from rust and maintained in such condition that any separation shall not exceed four thousandths of an inch. (2 per cent.)

(b) See that the flange surfaces are kept clean and smooth and use a film of vaseline or other grease on such surfaces. Would not allow the use of any defective, broken or welded part. (2 per cent.)

(c) Examine all capscrews, studs, nuts and bolts, and test the joint for tightness with a feeler gage. (2 per cent.)

Q.—Does the welding of a damaged part of permissible equipment impair the permissibility of the part?

A.—Yes. (1 per cent.)

Q.—Does the substitution of bolts having sizes other than those used at the time the machine was given approval impair its permissibility?

A.—Yes. (1 per cent.)

Limitations on Voltage

Q.—May coal-cutting and other portable machines and locomotives be used at higher than medium voltage?

A.—No. (1 per cent.)

Q.—With respect to ventilation, where may high-voltage transmission cables and high-voltage motors and transformers be installed in gassy mines?

A.—They shall be installed only in suitable chambers ventilated by intake air which has not passed through or by a gassy district. (2 per cent.)

Safety Apparel and First Aid

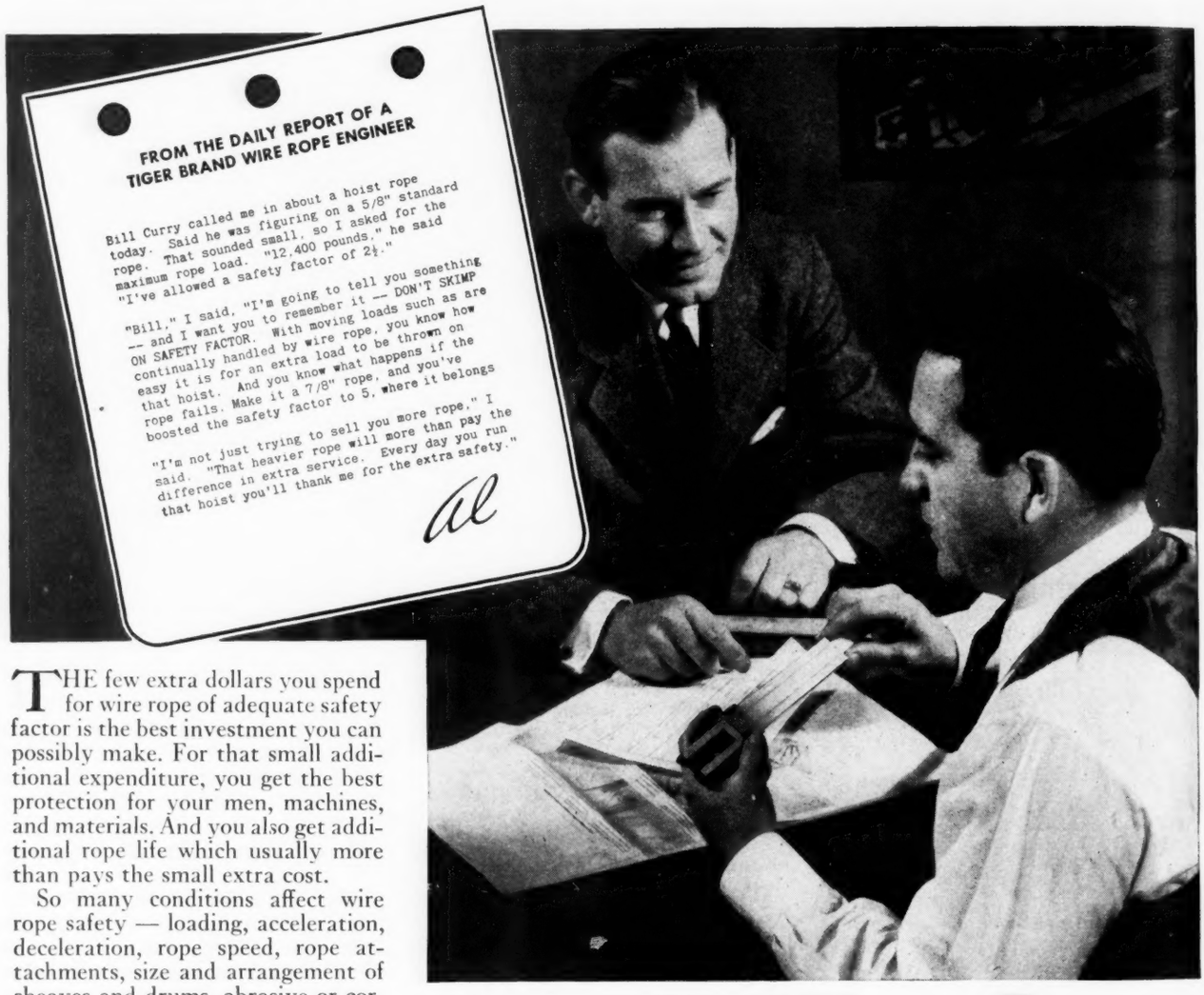
Q.—What materials and wearing apparel are required to be used by persons engaged in making repairs or adjustments to live parts of electrical apparatus?

A.—Gloves or mats of rubber or other suitable insulating material. (1 per cent.)

Q.—Is it unlawful for any unauthorized person to damage, alter or make connections to any part of an electrical system?

A.—Yes. (1 per cent.)

DON'T SKIMP ON SAFETY FACTOR


FROM THE DAILY REPORT OF A
TIGER BRAND WIRE ROPE ENGINEER
Bill Curry called me in about a hoist rope today. Said he was figuring on a 5/8" standard rope. That sounded small, so I asked for the maximum rope load. "12,400 pounds," he said "I've allowed a safety factor of 2½."
"Bill," I said, "I'm going to tell you something -- and I want you to remember it -- DON'T SKIMP ON SAFETY FACTOR. With moving loads such as are continually handled by wire rope, you know how easy it is for an extra load to be thrown on that hoist. And you know what happens if the rope fails. Make it a 7/8" rope, and you've boosted the safety factor to 5, where it belongs
"I'm not just trying to sell you more rope," I said. "That heavier rope will more than pay the difference in extra service. Every day you run that hoist you'll thank me for the extra safety."
al

THE few extra dollars you spend for wire rope of adequate safety factor is the best investment you can possibly make. For that small additional expenditure, you get the best protection for your men, machines, and materials. And you also get additional rope life which usually more than pays the small extra cost.

So many conditions affect wire rope safety — loading, acceleration, deceleration, rope speed, rope attachments, size and arrangement of sheaves and drums, abrasive or corrosive conditions. Usually one or more of these factors are variable and accordingly, difficult to predict accurately. Therefore, in order to avoid overstressing and subsequent disastrous results, allow adequate safety factors in figuring your wire rope requirements.

In case of doubt about safety factor, ask any American Tiger Brand Wire Rope Engineer. These men bring you, without obligation, all the practical experience gained from thousands of successful installations.

RECOMMENDED MINIMUM SAFETY FACTORS

Track cables	3.2
Guys	3.5
Mine Shafts	
depths to 500 ft.	8.0
depths 500 - 1000 ft.	7.0
depths 1000 - 2000 ft.	6.0
depths 2000 - 3000 ft.	5.0
depths over 3000 ft.	4.0
Miscellaneous hoisting	5.0
Haulage ropes	6.0
Overhead & Gantry cranes	6.0
Jib & Pillar cranes	6.0
Derricks	6.0
Small Electric & Air Hoists	7.0
Hot ladle cranes	8.0
Slings	8.0

EXCELLAY *Preformed* **WIRE ROPE**

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
For Anthracite Service: Miners Bank Building, Wilkes-Barre, Pa.

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL

WHAT'S NEW IN OPERATING IDEAS

Roof Drill Operation Aided By Hydraulic Jack and Arm

"A real money-saver" is the way Robert Andrews, New Jellico Coal Co., Morley, Tenn., characterizes the hydraulic mechanism for holding and spotting a roof drill shown diagrammatically in the accompanying sketch. Before the present equipment went into service, trolley-hanger holes were put in with a mechanical drill that had to be reset each time where it could be used at all. As the mine advanced, however, sandstone that the mechanical drill could not handle was encountered. Sufficient compressor capacity was not available for doing both advance work and drilling for the wiremen, "so, with the management's permission, I built this jack to put on a compressor. With the manual drill, where it could be used at all, it was taking half to two-thirds of the wiremen's time to drill the holes. With the oil jack, about one-tenth of their time is spent in drilling. We have built a compressor for this jack only 25 in. high, which can be taken anywhere in the mine."

The jack sets on a base which may be mounted as desired and includes a welded-in king-pin. A turntable revolving around this king-pin permits the drill to be turned to either side of the heading. On the turntable is mounted an oil-storage tank (5-in. inside diameter) with filler plug and connection to the air line; also the hydraulic-jack cylinder with an inside diameter of 4 in. The cylinder must be machined very smooth on the inside, and the piston fits snugly.

An inverted 4x5-in.-pump leather is fitted on the bottom of the piston to make a good oil seal. The piston is tapped with a ⅜-in. hole for mounting the pump leather, with a second hole for mounting the eye for the connecting rod for the hammer supporting arm. This arm is pivoted in a mounting bracket made of angles welded to the turntable. The air drill is mounted on the opposite end of the arm. An ordinary bleeder valve is installed in the air line to the oil-storage tank to admit pressure and thus force oil into the jack cylinder to raise the arm. Bleeding off pressure permits the arm to drop.

Exact dimensions, Mr. Andrews points out, will depend upon the builder's requirements and on the weight of the drill and the length of the supporting arm. The New Jellico unit, however, has an arm 6 ft. long. The jack cylinder is made of 4-in. double-strength pipe. With an air pressure of 65 lb. per square inch, the jack has an effective thrust of slightly over 800 lb.

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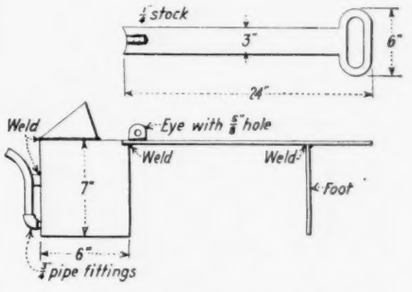
Convenient Design Featured In Babbitt Ladle

In shops where much babbitting is done a well-constructed and ample-sized ladle is a good investment, points out P. C. Ziemke, Milwaukee, Wis., in suggesting the type of ladle shown in the accompanying sketch. The body of the ladle is made of a 7-in. length of 6-in. pipe in the bottom of which is welded a disk cut from scrap plate. The handle, welded to the top of the ladle, also is made of scrap plate with an ample-sized D-shaped opening to accommodate a man's gloved hand; also a foot to prevent the weight of the handle tipping the ladle over when it is set on a bench or floor. At the point where the handle is welded onto the ladle, an eye with a ⅝-in. hole is welded on. This eye accommodates a hook which is grasped in the worker's left hand in carrying and pouring.



Construction of babbitt ladle.

The handle may be welded on in several positions, depending upon the relation of the furnace to the work and whether the man is right- or left-handed.

To insure a clean flow of metal free from dross and floating impurities, and from sediment in the bottom of the ladle, the pouring spout is brought out from a point slightly up from the bottom. The outlet is a ¾-in. pipe nipple, and the remainder of the spout is made up of pipe and fittings, tacked to the ladle to hold them rigidly in place after they are screwed up. To complete the job, the top of the ladle on the spout side is covered with a half-moon-shaped section of light plate, which prevents spillage over the ladle lip.

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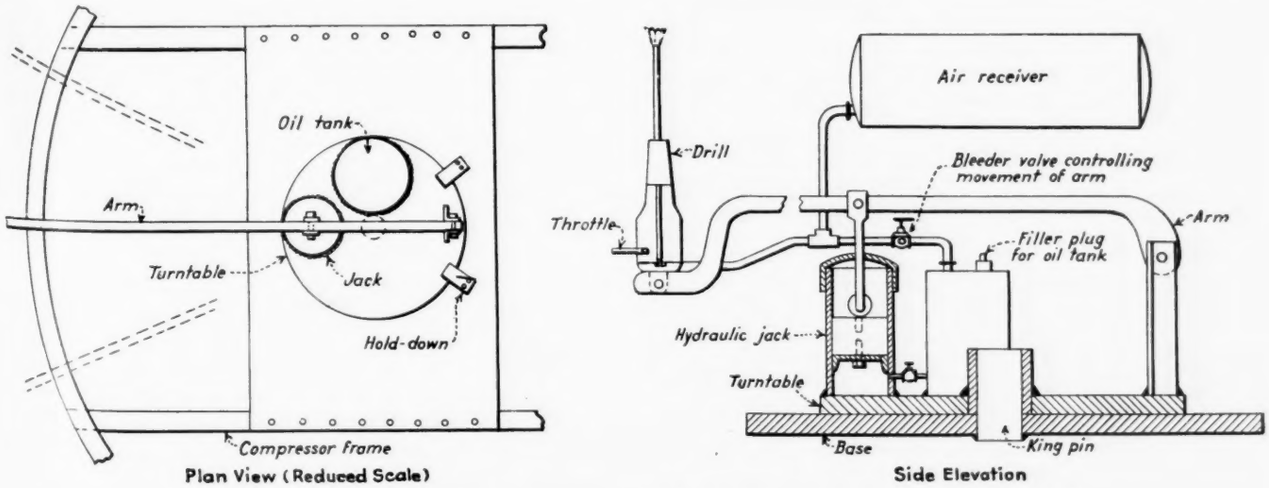
Latches and Special Ties Used For Quick Track Extension

Two suggestions for speeding up the extension of track at the working face are supplied by E. Evan Jones, Richlands, Va. One of these, a special joint tie, was awarded a prize in the miners' gadget display at the



Plan View (Reduced Scale) — Side Elevation

Diagrammatic sketch showing general arrangement of unit for supporting pneumatic hanger-hole drill.

Bluefield (W. Va.) Industrial Exhibit held late in August. The major features of the joint tie are shown in Fig. 2. The clips opposite the rail joint are beveled so that swinging the tie about 40 deg. causes it to engage the rail. The joint then is made by swinging the advanced rail until the end bolt hole engages one of the studs on the outside clip. A second stud holds the other rail, while an inside clip keeps both rails in engaged position. No tools are required in making the joint.

Mr. Jones' second suggestion for quick track extension is a portable track section joined to the main track by two switch latches and clamps. Except for one special tie at the latch joints, standard steel ties are used—both under the main track and the portable extension. "Jumpers," or short extension rails, are eliminated, and 30-lb. steel may be advanced 10 ft. per minute, Mr. Jones states. This type of portable extension is used by the Splashdam (Va.) mine of the Splash Dam Coal Corporation.

How the special tie employed at the joints is made up is shown in Fig. 1. This tie also is used, along with the latch clamps, to connect the extension and the main room track. The rails in this track are bent temporarily at the latch points, and the latches are held in place by wooden wedges driven in under the clamps as shown in Fig. 1.

To move the portable track section ahead, the loose end of a main rail is pried out beyond the end of the latch tie, which then is lifted on top with a bar. The same thing is done on the opposite side, with the result that the back end of the portable section, 30 ft. long, rests on the rails in the main track. Thus, a man, by using only one hand in many cases, can slide the portable section either forward or backward as the case may be.

This method of extending track, says Mr. Jones, can be used in angle-face work, circle-face work or parallel-face work, and is particularly adapted to mechanical loading.

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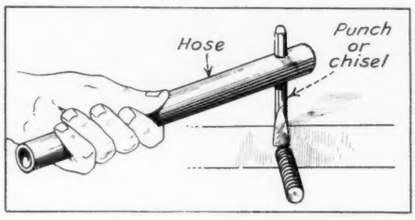
Handle for Cutting Tools Assures Safety to Worker

In general mine maintenance and repair work it sometimes is necessary to cut off nuts and bolts or punch out rivets. A safety device for such work, which is shown in the illustration, has been developed by Walter Hornsby, general foreman, Glogora Coal Co., Glo, Ky.



Safety handle lessens danger to repairmen.

Using a piece of suction or air hose, a small hole is cut through at right angles to the bore, in which the punch or chisel can be inserted, forming a handle with the hose, allowing the tool to be held in any position and struck with a sledge without danger to the holder.

Hay-Making

The prudent man gives thought to the future. Thus, the farmer "makes hay while the sun shines." This maxim applies just as strongly to coal mining. Things may be going smoothly at the moment, but that is no reason for not planning for difficulties that may come in the future. To help operating, electrical, mechanical and safety men lay up a little knowledge for use when troubles crop up, Coal Age maintains this Operating Ideas department. Your kink may save some other man a lot of grief. So send it in, with a sketch or photo if it will help to make it clearer. For each acceptable idea, Coal Age will pay $5 or more on publication.

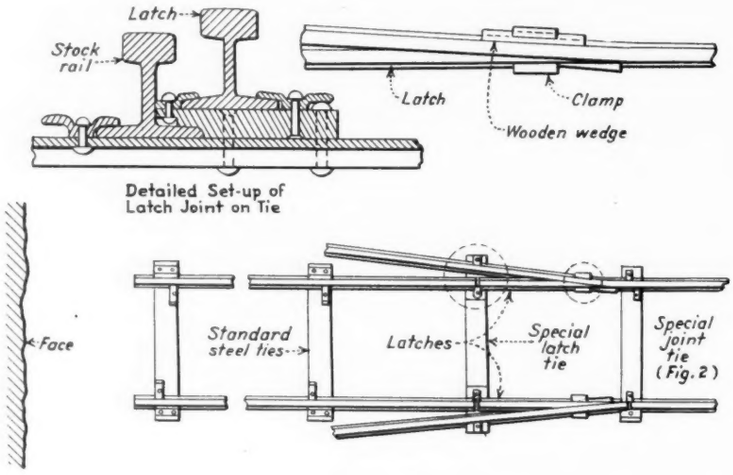


Fig. 1—Details of portable track extension using latches as connectors; also details of special latch-joint tie.

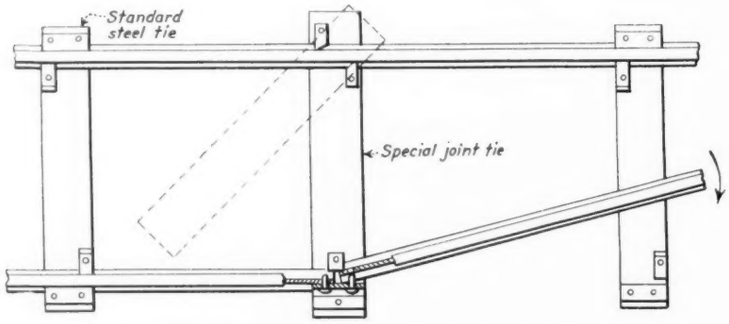


Fig. 2—Details of special steel joint tie for straight track.

New Conveyor-Pan Design Smooths Flight Travel

A flight conveyor of new and interesting design is being built by one of the leading coal companies in central Pennsylvania, says F. Fraser MacWilliams, Johnstown, Pa. Before starting this work, the company made dynamometer and power-consumption tests on various makes of conveyors under operating conditions, finding that the average 30-ft. face conveyor with chain-and-flight weight of 5 lb. per foot could not be operated satisfactorily with less than a 2-hp. motor; in fact, the 1-hp. motors furnished originally were burning up continually.

Experiments were made with a conveyor holding 20 lb. of coal per foot and a flight and chain weight of 3½ lb. per foot. Dynamometer tests showed the drawbar pull on the empty conveyor to be 45 lb. per 100 lb. of flight and chain and 65 lb. additional for each 100 lb. of coal.

The maximum capacity of this lighter conveyor is 20 lb. per foot, which, if operated at capacity at a speed of 80 ft. per minute, would provide 1,600 lb. of coal per minute, or 48 tons per hour. It was found that with four men, the maximum they could load on the conveyor was about 24 tons per hour, or 168 tons per 7-hour shift, so that even this lighter conveyor could handle far more than ever would be required. The power input for the lighter chain is a great deal less, however, since the total moving weight per 10 ft. is only 700 lb. with a necessary drawbar pull of 315 lb. empty. The additional 650 lb. necessary for a 1,000-lb. coal load makes a total of 965 lb., which at 80 ft. per minute makes a total load of 77,200 foot-pounds, or 2.34 hp. Thus, with this chain and conveyor, a 3-hp. motor is ample for a 100-ft. conveyor, or 1 hp. for one of 30 ft.

This company's experience, Mr. MacWilliams reports, has shown that a pan shaped as shown in the upper sketch herewith is

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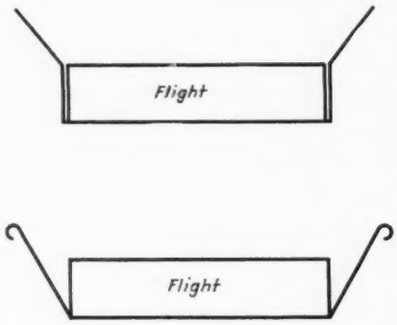


Variations in conveyor-pan construction. The upper, one company's experience indicates, is preferable.

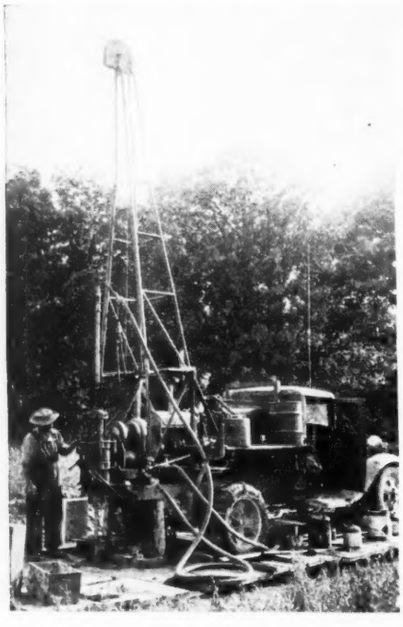
much better than the lower type, as the flight travels more smoothly. With the latter type the lumps roll around and a great deal more spillage results. It also has been found that having the bottom of the flight leading so that the flight angle is 60 deg. is of definite advantage when handling slack coal.

•

Own Prospecting Drill Pays at Kathleen

Like many other operations in southern Illinois, the Union Colliery Co., Dowell, Ill., finds occasional faults in the coal seam, and to save wear and tear on nerves and the cost of hunting up and down from the mine workings has purchased a Sullivan No. 12 diamond core drill (shown at work in the accompanying illustration). This drill saved its cost on the first job and since has been used to prospect the entire unmined area, lying 70 to 300 ft. below the surface.

The drill is gasoline-powered and can be fitted with an electric or air drive, the latter with the idea of using it underground when occasion arises. The unit consists of four major parts: hoist, engine, swivel head, which can be set to drill at any angle, and frame. A water pump is separate.



Kathleen prospecting drill, mounted on a second-hand truck, at work on the surface.

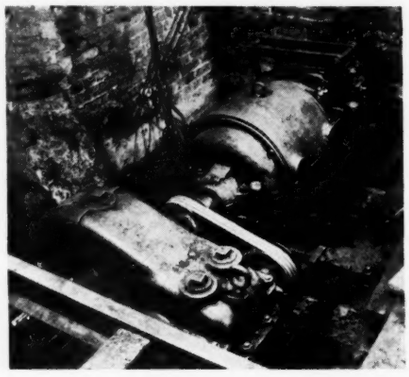
Maximum drilling depth is 600 ft. The drill uses a fishtail bit in surface material, with a diamond coring bit taking a 2⅜-in. core in rock.

For surface work, the drill is mounted on a truck for ready portability. It is operated by a two-man crew, which can drill and core a 240-ft. hole in an average of six shifts.

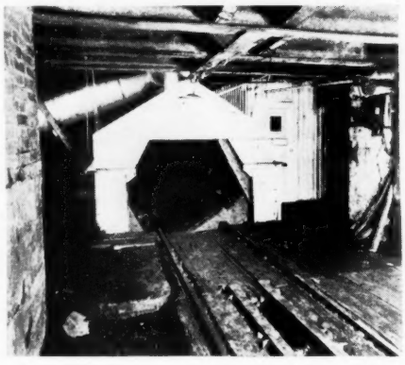
•

V-Belts Act as Limiter On Car-Haul Capacity

"The Northwestern Mining & Exchange Co. recently installed at its Kramer mine, Stump Creek, Pa., a novel rotary car dumping arrangement designed by J. H. Nagle, chief engineer," reports F. Fraser MacWilliams, Johnstown, Pa. "Originally, the car haul was operated by a positive drive through a gear reducer, the total reduction in speed being very high. Due to this high reduction,



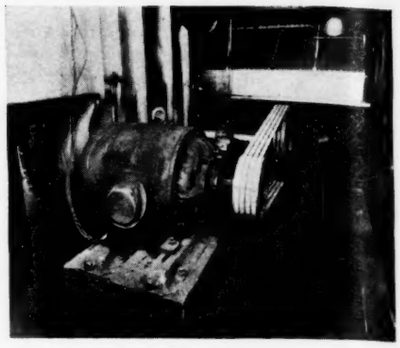
The three V-belts will just pull a 45-car trip.



Showing hood and suction ducts over dump.

any jamming or fouling of the chain would wreck either bearings or reducer before the strain was released by the line fuses on the motor. Every such occasion caused a very high repair expense, so a V-belt drive was designed as pictured in the accompanying illustration.

"The three belts shown are worked to their very maximum capacity to transmit the power from the 25-hp. motor to the reducer. This capacity is adjusted so closely that, although the standard trip of 45 cars can be spotted very nicely, an addition of only two cars will cause the belts to slip. The drive thus acts as a safety link, or fuse, and the maximum cost of any breakage is limited to the replacement cost of the belts themselves and is comparatively small. Four belt sheaves



This fan discharges dust into a baffle system in a crosscut.

were installed to permit handling 60 cars per trip should this become necessary.

"The illustration of the dump itself also shows the very efficient dust collector which has been installed. The dump is covered by a manifold with two large discharge tubes connected through a Y to a powerful fan. This fan, driven as shown in the third illustration, sucks all dust from the dump and discharges into a near-by crosscut. The discharge is into a series of baffles which are continually sprinkled with water to lay the dust, which can then be easily loaded out once a week."

•

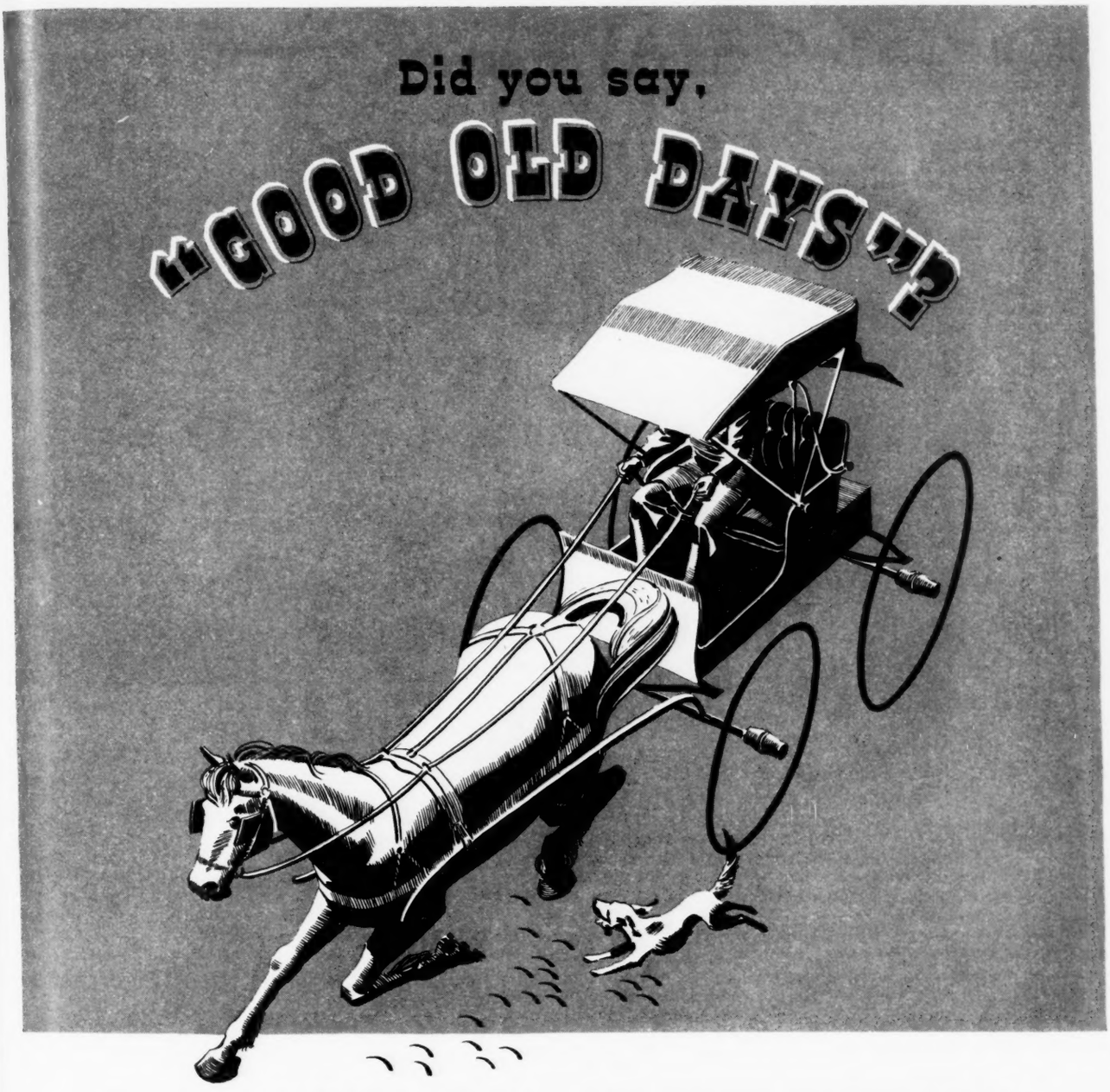
Instrument for Obtaining Levels Uses Gage Glasses and Tubing

Pointing out that there are many occasions when a mine foreman, timber boss, tracklayer or others want to establish grades in places where the usual chalk lines or other devices are not practicable, P. C. Ziemke, Milwaukee, Wis., suggests the instrument shown in the accompanying illustration for determining differences in elevations when engineers are not at hand. It is used where distances from a bench mark or other station are not far. The parts are: two ⅜x2-in. brass nipples, 50 ft. of ⅜-in. i.d. high-quality rubber tubing, two water-gage glasses (¼-in. i.d., 12 in. long), two 14-in. lengths of ¾-in. brass tubing, two brass petcocks, two ¼x12-in. stainless-steel rules, two 2x2x14-in. oak blocks, and two ¾x⅜-in. brass bushings.

The brass tubing is prepared by grinding away sufficient metal on diametrically opposite sides to permit the scale to be read through the opening. Then the gage glass, after being well coated with litharge to form a watertight joint, is slipped into the brass tube. Next, the scale, with its calibrated side inward, is attached to the brass tube by sweating a brass strip to both tube and scale. The lower end of the brass tube then is fitted with a bushing and nipple to permit attaching the rubber tubing and the upper end of the brass tube is closed by sweating the petcock in place.

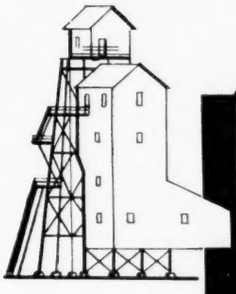
Next, the 2x2-in. oak block is grooved ⅞ in. deep (round bottom on a ¼-in. radius). The gage assembly, with the petcock handle outward and the scale visible through the glass, is fitted into the groove. With both units completed, water is poured into the instrument through one petcock, opening the other to vent the air, until one-half of the gage scale is covered.

In service, one unit is held vertically so that the water level is in definite relation to an established elevation or bench mark. The



Remember back when "Dobbin" clop-clopped along and you cranked your telephone? Technical advancement and increased efficiency have replaced these heirlooms with streamlined autos and overseas telephones . . . but let's not forget that it also placed new demands on the coal industry.

Specially prepared coal is the demand today . . . clean, screened, purified coal with *constant* physical properties that give *constant* economy. If your coal preparation equipment "dates-back", why not call in a Morrow Engineer? He can modernize your tipple at *economy* prices with practically no disturbance to your present production. Let's talk it over!



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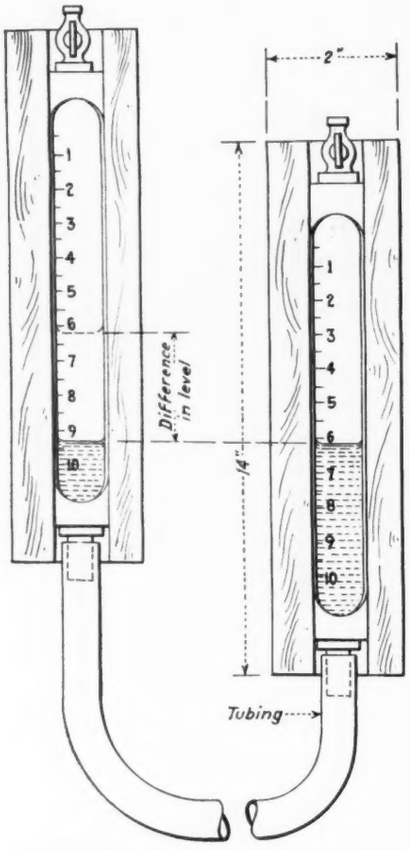


Completed leveling units showing one method of use.

companion unit then is carried around any obstruction by a second party. The water level in the second unit naturally has a definite relation to the level in the first, and with the difference known or the levels in both glasses made the same, a new bench mark may be established, from which vertical measurements either above or below may be made.

•

Bells on Mine Locomotives For Greater Safety

Accidents involving mine-haulage equipment are far too numerous and serious to be ignored or considered unavoidable, says Paul C. Ziemke, Milwaukee, Wis. Both the frequency and severity of such accidents, however, can be reduced materially by installation of proper safety equipment, such as bells, proper headlights and block signal systems.

All manufacturers equip their locomotives with the regulation street-car type of warning gong, either hand- or foot-operated. However, these as a rule are short-lived because of their light construction, and the motorman is inclined to stop sounding it after the initial blow or two because of the rather clamorous and inharmonious tone. A worth-while improvement is the adoption of a much better unit which for years has been successfully employed on standard-gage engines and city fire apparatus—the bronze bell with center-hung clapper.

One large mining corporation, which operates heavy trains at high speed over long distances and has numerous lighter units doing gathering service, has every locomotive equipped with a 10-in. bronze bell. These bells are purchased with only the clappers attached. The yoke, trunnions and mounting frame are forged and arc-welded in the mine shops at minimum cost. Bells are mounted by bolting them to the center section of the locomotive cover and a $\frac{3}{8}$-in. tar-treated rope is extended from end to end of the locomotive so that either the motorman or the "nipper" can do the ringing.

The clear melodious notes of these bells are not nerve wracking and tiring and can be distinctly heard over three times farther than the old gong. Thus the haulage crew diligently sounds the bell as the trip rolls along. Several operating companies have gone a step further and have improved the situation by mounting the bell rigidly and causing it to be struck by a roller and cam arrangement in contact with a locomotive wheel. This arrangement, however, has the drawback that it does not permit the bell to be sounded prior to starting in motion and makes for considerable needless ringing. A few drops of oil per day on trunnions and clapper suspension keeps these units operating efficiently and economically over a long period.

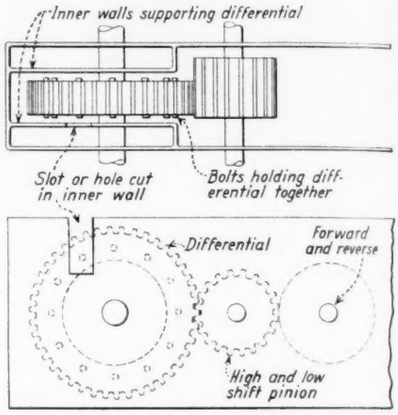
•

Angle Iron Placed on Mine Door Stops Trailing of Trips

In some cases, mine doors are especially equipped to permit trailing trips through them; in other cases, depending upon the custom at the mine, butting doors open with locomotives and trailing trips through them is prohibited. Where the latter is the rule, L. E. Walker, section foreman, New River Co., Summerlee, W. Va., reports that bolting short angles to the doors as shown in the accompanying diagrammatic sketch is very helpful in preventing attempts to open the doors by striking them with the locomotive, as well as attempts to trail trips through them. This results from the fact that the angle hangs to locomotives or cars unless the door is latched or held back out of the way, whereas otherwise it might be possible for a trip to get through, though it probably would strain or damage the door, pull it askew or otherwise harm it so that repairs would be necessary.

Loader Differential Bolts Replaced Through Slot in Housing

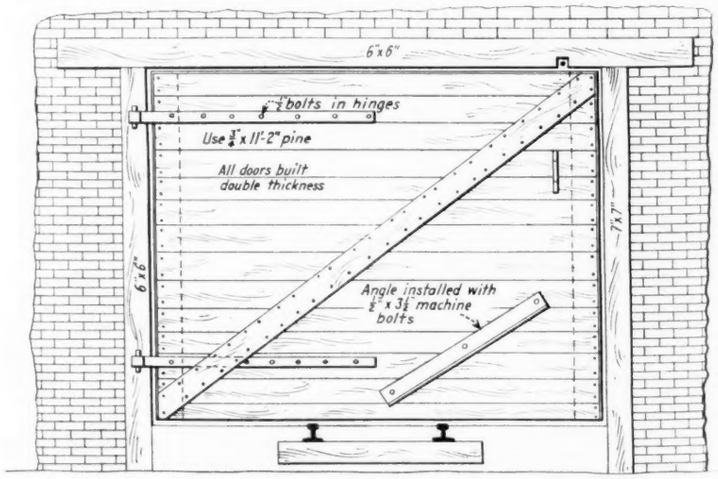
Bolts holding together the differentials in Joy 5BU and 7BU loading machines are subject to breakage, writes Thomas James, mine foreman, American No. 2 mine, Knox Consolidated Coal Corporation, Bicknell, Ind., in suggesting a convenient means of replacement. As the inner wall of the differential housing is only about 1 in. from the differential, "it is impossible to replace a broken bolt or bolts without taking down the whole back end of the machine. This means about 7 hours' labor for two men. It also


Inner walls supporting differential
Slot or hole cut in inner wall
Bolts holding differential together
Differential
Forward and reverse
High and low shift pinion

Showing how slot facilitates changing differential bolts.

means that when the machine is inspected and one or more bolts are found to be broken the machine often is allowed to run until something else is torn up on account of this differential fault.

"By cutting a slot in the inner wall, as indicated in the accompanying sketch, or burning a hole in it with a torch when the machine is in the shop for repairs, big enough to let the head of the bolt through, any broken bolt can be replaced in a few minutes and costly breakdowns from this cause avoided. If the loading machine is needed, a slot can be cut with a hacksaw and hammer and chisel and the machine can be back in production in a short time. Once the hole or slot has been made, changing bolts is a part of the regular routine."



Showing angle applied to mine door so that it must be latched open before locomotive or trip can go through.

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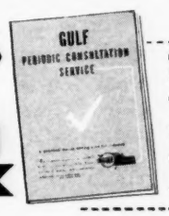

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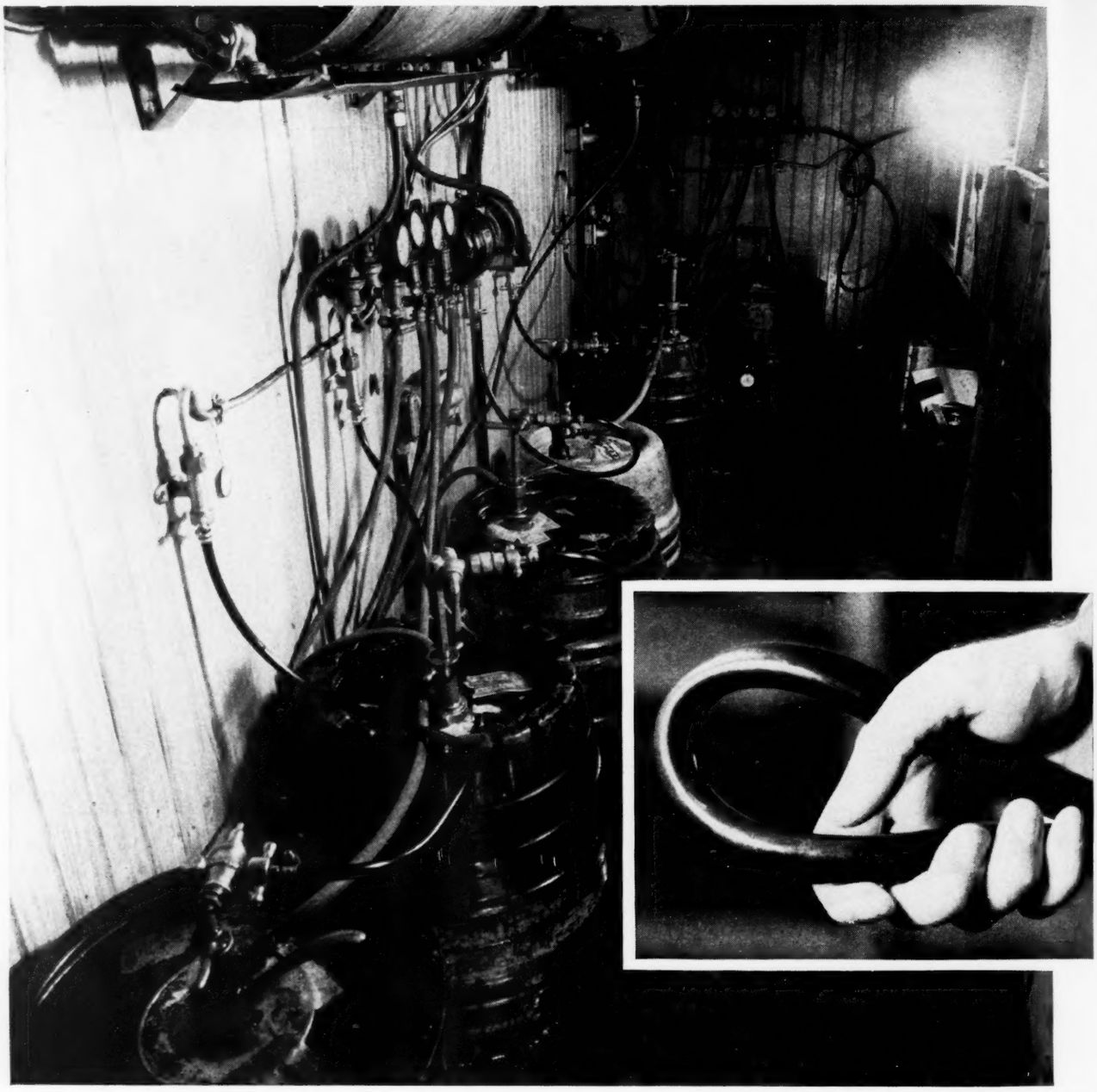

Elbow bending begins in the cellar

A typical example of Goodrich development in synthetics

AT MOST BARS beer travels a long way before it reaches the tap — from barrels deep in the basement where constant cold protects the flavor. But these basement refrigerated rooms were a constant worry to the bartender.

Because beer barrels must be shifted, the tubing from barrel to fixed pipe must be flexible. Soft metal was used but it broke at the elbow just as wire breaks if you bend it a few times.

Goodrich engineers had an idea. They had developed a new synthetic called Koroseal, as flexible as a rubber band and so impervious to liquids it was used to line acid tanks. Why couldn't it be used as beer tubing?

They tried it, and added a smooth "fire polish" to make cleaning easy. This Koroseal tube has now been in use more than a year — not a piece has broken and so cost is less, it's easier to keep clean, it is as tasteless as glass. Koroseal is now standard with the largest breweries and beer equipment manufacturers.

This same Koroseal, by the way, is the same product other manufacturers are using to make permanently waterproof, stainproof raincoats, shower curtains, tablecloths. But that's another chapter — another chapter in the fascinating continued story of Goodrich research. *The B. F. Goodrich Company, Mechanical Division, Akron, O.*

Goodrich

ALL *products problems* IN RUBBER

(Another story of Goodrich development appears on page 1)

WHAT'S NEW IN THE FIELD

Recurring Anthracite Problem Not Yet Solved By Output Allocation Scheme

By JOHN M. MEIGHAN

NEWS stories and editorials in leading papers in the anthracite region of Pennsylvania would indicate that all is not "beer and skittles" with the producers' plan for allocation of tonnage which was adopted with much gusto and fanfare on Jan. 29 last. One headline in a recent issue of a prominent anthracite newspaper states that "Inglis Sees Anthracite Tonnage Allocation Plan Foundering in Short Time" (the reference is to Major W. W. Inglis, president, Glen Alden Coal Co.). In this news article, Major Inglis is quoted as calling attention to reports of some 27 violations of the tonnage control plan in one week. He also is reported as stating that his company has a club "which it can use to good effect, and that it will be greased up for use pretty quickly unless there is a sudden and unexpected turn for the better in the operation of the allocation program." Belief was expressed in a later story that the club Major Inglis had in mind was the company's ability to slash prices in the coal markets.

In a front-page editorial, four days later, one of these papers argued that when one party to an agreement breaks the pact he destroys completely or in part the underlying principle of the working plan or production plan set up in the agreement, and strongly intimated that there should be no quarrel with any company disregarding the agreement once it had been broken by another company or companies.

Applause Conspicuously Lacking

Other news stories earlier in the year indicated that there was not complete satisfaction either among producers or labor over the way the production control plan was working out. The coal platform pledge by the Democrats to give to anthracite the same method of legislative control as is exercised over the bituminous industry, reportedly adopted at the instance of labor, followed by a story that officials of District 1, United Mine Workers, would meet in Scranton to "curb violations of the coal plan" would give the appearance that labor was not any too sure of the continued success of the program.

Also, Congressman Flannery's resolution adopted by the House of Representatives providing for an investigation of the anthracite production control plan indicated doubt on the part of some of the Congressman's constituents as to the plan's continued operation, for, in addition to stating that Congress should be informed of the relation of the anthracite plan to effective conservation and to the interests of consumers in states other than Pennsylvania, it provided for the appointment of a committee to study the advisability of Federal action to supplement the Pennsylvania program in order to increase the operation of anthracite mines. Of course, the Congressman's action may have been wholly on his own initiative, but it also is probable that he was fully informed as to the views of both the producers and labor before the resolution was introduced and was convinced of the necessity of something more official than a voluntary allocation plan in order to keep production of anthracite under reasonable control.

The history of anthracite is replete with instances of agreements of one kind or another being entered into and broken. The trouble always has been that there is no way of insuring adherence to operating or other agreements other than by threats of reprisals—usually a price war—if the agreement be not carried out to the letter. Such threats usually serve for a short time as a deterrent to violators, but in the end there is a general breakdown and many individual units in the industry—innocent as well as guilty—are faced with the necessity of dumping coal at less than cost or shutting down entirely.

In the present situation it was hoped that with the Governor of the State a party to the plan there would be a general hesitancy about any operator disregarding any percentage allocation assigned to him. The weakness in this expectation was that the Governor had no more authority to enforce a voluntary agreement of the kind adopted than would a committee of operators acting on their own. One other practical factor interfering with complete adherence to the agreement was a feeling on the part of some operators that the percentages were too arbitrary in their application. That is, they felt they were assigned percentages which they, under normal expectations, could exceed, while other operators were given percentages in excess of any demands which might be made of them. As a consequence, and in the absence of punitive authority, operators having percentages lower than necessary for them to fill their market demands have exceeded their quotas and by so doing have aroused the wrath of those operators who are adhering to or lagging behind the amounts assigned to them.

The fact that there is a compensating difference in the quantity of coal mined in excess of the quotas assigned and the tonnage by which certain operators fail to meet their quotas would lead anyone to believe that all operators were abiding by their agreement—at least until someone like Major Inglis gives voice to a complaint. Taking figures of two companies, for example, we find that for the six months starting Jan. 29 one company ran 158.8 per cent ahead of its quota and another was 4.3 per cent behind its allowance. Despite the great apparent difference, the company running 158.8 per cent ahead had exceeded its quota by only 10,560 tons, while the one lagging was about 32,000 tons below the quantity allocated to it. At that time there were a number of companies exceeding their quotas, but the variations between the quantities scheduled by the Emergency Committee and the tonnage actually produced was not over 1.5 per cent. From this it will be seen that total figures mean little and that there could be a large number of violators of the plan without their respective delinquencies being known from a comparison of tonnage allocated and tonnage produced.

Pressure on Violators Likely

Acknowledging, then, that the allocation plan is being violated and that Utopia has not yet been reached in the anthracite field—what now? The union has intimated it will bring pressure on violators and one of the largest producing companies has said it has a club ready to use on operators who will not behave. Here we run against a serious legal question. From past expressions of the Federal courts there were serious doubts in many quarters as to the legality of control of production in an industry such as anthracite before clubs and other forms of pressure were mentioned—doubts, that is, in the absence of any legislative action based on the necessity for conservation with definite standards of regulation stated by the Legislature. What

Born in Wilkes-Barre, Pa., Nov. 30, 1898, John M. Meighan was educated in the public schools, the National School of Commerce and George Washington University, Washington, D. C., where he studied economics, including statistical analysis, accounting and law. His early employment included connections with the Lehigh Valley and Delaware & Hudson railroads. He also has had various assignments with the Federal Government, largely involving research and statistical analysis. These included the Interstate Commerce Commission, the old U. S. Coal Commission and the U. S. Veterans Bureau. With the formation of the Anthracite Operators' Association he was retained as temporary executive secretary and served in that capacity until Dec. 31 last, resigning to engage in public relations work.

would the courts say now about an agreement, enforced by pressure, if they found it to be in restraint of trade, in violation of the Sherman Act? Might not the question of triple damages arise where, in the absence of any pressure or threatened pressure, only an injunction would be expected?

While the courts have not frowned upon all agreements among competitors and have even ignored charges of restraint where improvement of prices was the intent of cooperative action, they have, despite a number of contradictory opinions, pretty well defined the limits beyond which such agreements may not go. There was, for example, the *Appalachian Coals* case. In that case the Supreme Court said: "A cooperative enterprise otherwise free from objection which carries with it no monopolistic menace is not to be condemned as an undue restraint of interstate commerce in violation of the Sherman Act merely because it may effect a change in market conditions where the change would be in mitigation of recognized evils and would not impair but rather foster fair competitive opportunities."

It should be noted in connection with the Appalachian agreement that only a comparatively small section of the bituminous field was involved and that there was no attempt to control production. Two cases more in point are *Gibbs* v. *McNeeley*, 118 F. 120, and *Maple Flooring Manufacturing Association* v. *United States*, 45 S. Ct. 578, 268 U. S. 563.

In the *Gibbs* case the court had this to say: "An association of manufacturers of and dealers in red cedar shingles in the State of Washington formed for the purpose of controlling production and the price of such shingles, which are made only in that State but are principally sold and used in other states, and which by its action in closing the mills of its members has reduced the production and has also arbitrarily increased the price at which the product is sold, is a combination in restraint of interstate commerce and unlawful."

Maple Flooring Case Cited

The decision in the *Maple Flooring Manufacturing* case read in part as follows: "Any agreement or concerted action to use trade information, properly gathered and disseminated, to lessen production arbitrarily or to raise prices beyond the levels of production and price which would prevail if no such agreement or concerted action ensued, constitutes a restraint of commerce and is illegal and may be enjoined."

It may be argued, of course, that sentiment today in the Supreme Court may be considerably different, but it is doubtful, in view of the court's recent decision in the oil cases whether the above enunciated principles would be changed in the matter of production control. The high court's ruling in the oil cases, handed down on May 6 of this year, sustained a ruling of the Federal District Court at Madison, Wis., which held that twelve major oil companies and five individuals violated the Sherman Act by conspiring to control the price of gasoline as sold in ten Midwestern States. The oil companies, in defending their action, contended that they engaged only in "a voluntary cooperative effort" to remove "a competitive evil—distress gasoline"—and that the resulting prices were not unreasonable.

Does this last have a faintly familiar ring when considered in connection with anthracite? True, the anthracite plan does not directly provide for price fixing, but no one will deny that the purpose of the control of production is to bolster prices.

In the aforementioned oil case, Justice Douglas, who delivered the opinion of the court, said that a conspiracy to affect prices violated the Sherman Act even though the resulting prices were reasonable. He said further: "Under the Sherman Act a combination formed for the purpose and *with the effect of raising, depressing, fixing, pegging or stabilizing the prices of a commodity in interstate or foreign commerce is illegal* (the italics are mine).

From the foregoing, it would appear that while cooperative efforts to alleviate distress conditions are not forbidden such efforts will not be tolerated under the Sherman Act if they involve control of production or of prices or the control of production if such control is for the purpose of pegging a price for an entire industry. If this be done, then any effort to force adherence to the allocation plan might precipitate legal action which not only would dissipate any benefits the allocation plan has brought about but which would make any form of production control inoperative until legislative action could be obtained.

It may be that under the practical and legal difficulties here outlined the production control plan is out in any event, but it would seem somewhat foolish, considering the benefits it has brought to the industry, to hasten unduly its demise.

•

New Slants on Miners' Safety and Health Stir Interest at Safety Congress

SAFETY and health, participation of management in safety, the work of the safety inspector, roof testing and use of methane detectors comprised the solid fare at the sessions of the Mining Section during the 29th National Safety Congress and Exposition, at Chicago, Oct. 7-9, with A.D. Campbell, safety engineer, McIntyre Porcupine Mines, Ltd., the general chairman, presiding.

In the inauguration of a safety campaign, asserted F. E. Bedale, assistant to general manager, in charge of safety, Consolidation Coal Co., patience and care are needed in dealing with foremen, who naturally resent being told what they should do, especially when criticism comes from a new source. It is necessary to study each foreman's accidents before approaching the matter actively, but when the foremen are classified properly from the company's files, those with bad records can be more readily brought into line and the instruction they need can be determined in each case.

Foremen should have not only State certificates of competence but U. S. Bureau of Mines training certificates both for mine rescue and first aid. They must also be able to impart their knowledge and experience to their men or they will fail to obtain safety. On occasions, foreman and inspector should go together through the working places and both should record what violations they note, and they should compare their findings after they have left the working place.

All lost-time accidents should be classified as to responsibility. Usually this is done each month by mine officials in conjunction with the safety department. The classification places each accident as having one of the following causes: (1) substandard conditions, (2) violations of rules, (3) lack of or poor supervision, (4) carelessness, (5) unavoidable, (6) doubtful as to compensability. Substandard conditions, when known to predate the accident, show poor supervision; violation of rules evidences lack of discipline; carelessness exhibits both poor supervision and a lack of effort of the foreman to educate his men.

Standardization, said H. C. Henrie, general superintendent, Copper Queen Branch, Mines Division, Phelps Dodge Corporation, is needed before discipline. Everyone—the workman, the foreman and the inspector—must know just what is the recognized safe way of performing every piece of work, or discipline may be unjust and uncertain. It is well that the night foremen know that they are promising candidates for shift boss. It will make them zealous to acquit themselves well. An inspector should be sent with them occasionally to note their efficiency and give them needed instruction.

Care must be taken to see that the activity of the inspectorate is not such as to usurp the functions of the foremen, who may readily be led to believe, said A. D. Campbell, that safety is "not their baby" but that of the inspectorate. Responsibility for safety, declared Dan Harrington, chief, Health and Safety Branch, U. S. Bureau of Mines, cannot be delegated, nor can safety work be headed by a $150-a-month man. It must be a job as well officered as that relating to production. The work must not be left to these men for six months or a year with, at the end of that time, a casual inquiry as to the result obtained. Management must be on its toes about safety, just as it is about production, accounting or sales, where management watches performance day by day.

However, asserted C. W. Gibbs, general manager, Harwick Coal & Coke Co., though he fully indorsed the need for executive interest, he tried to start from the bottom

Keeping Step With Coal Demand

Bituminous Coal Stocks

	(Thousands of Net Tons) Sept. 1, 1940	Aug. 1, 1940*	Sept. 1 1939
Electric power utilities	11,003	10,599	7,500
Byproduct coke ovens	7,832	7,448	5,632
Steel and rolling mills	660	605	542
Railroads (Class 1)	5,675	5,240	4,224
Other industrials†	14,422	13,686	9,526
Total	39,592	37,538	27,424

Bituminous Coal Consumption

	(Thousands of Net Tons) Aug. 1940	July 1940*	Aug. 1939
Electric power utilities	4,341	4,079	3,824
Byproduct coke ovens	6,703	6,603	5,177
Steel and rolling mills	792	715	719
Railroads (Class 1)	6,624	6,391	6,075
Other industrials†	8,624	8,089	7,623
Total	27,084	25,877	23,437

* Revised. † Includes beehive ovens, coal-gas retorts and cement mills.

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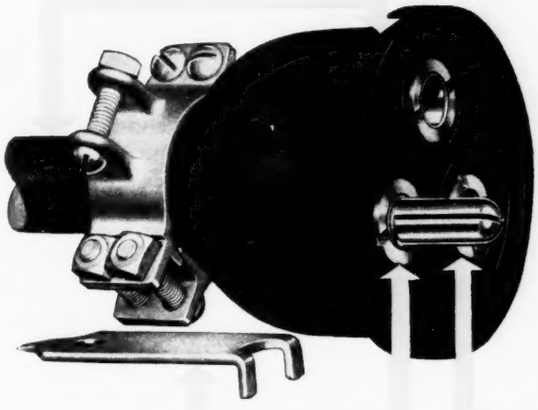
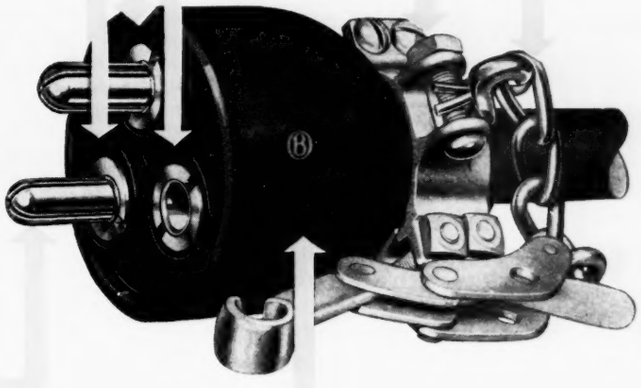
FOOL-PROOF ASSEMBLY Color key clearly identifies positive, negative and ground circuits, preventing improper connection of cable during installation in the field.

POSITIVE DOUBLE-CHAIN LOCK Plug cannot be pulled apart by dragging equipment or cable strain. Heavy galvanized clamping bands provide strong, dust-free joints.





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NON-CORROSIVE PLUGS Split for spring action and tight fit. Variation in size prevents improper insertion. Ground plug, only, protrudes from "power end" half of plug.

INSULATED RUBBER BODY Completely protects both man and device from electrical shock and mechanical strain or impact. Simple, one-piece construction.

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Portland, Maine

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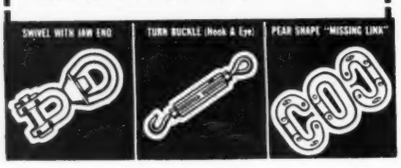

and distributed blanks to the men asking each of them to list some practice that should be remedied. During the first week, eight or ten suggestions were received, and prizes in merchandise were awarded. Then the blanks with annotations began to come in a flood, and success seemed assured.

Formation of standards, declared R. D. Hall, engineering editor, *Coal Age*, gave the employee additional objectives. He is no longer seeking only to produce coal; he is minded also to do the auxiliary work in the manner directed and to accomplish it at the exact moment in the cycle as prescribed. The workman now has at least three objectives instead of one and instead of finding posting or other proper direction of his place as a distracting and annoying task, depending, as it does, on contingencies which he hopes will not occur or may be delayed, he recognizes it as all part of the day's duties, and not irksome, because expected and already anticipated. It soon becomes a habit to perform these minor duties; they are part of his life which he does not question. They are like drill in the army. It is not a matter for discussion but for prompt and complete compliance.

Increased Output per Man

Standardization, responded Mr. Bedale, when it was introduced by his company into West Virginia, was greatly criticized as hampering production. Instead it appeared to have increased output per man 10 per cent.

Presenting the material covered by his articles that appeared in *Coal Age*, September, p. 62; October p. 166, and will be concluded in the December issue, J. E. Jones, safety engineer, Old Ben Coal Corporation, suggested that miners might do well to use a special tool for testing roof rather than any of the equipment now available from the miner's regular kit. What that tool should be ought to be determined by careful experiment.

He advocated feeling for vibration of the rock when sounding. When it is felt, it is an absolute evidence of roof weakness. He believed that in the prevention of accidents the personal ability of a man is more important than his experience.

A motion picture of methods of combating dust in Ontario mines was presented by C. Gibson, engineer and secretary of the Technical Silicosis Research Committee, Ontario Mining Association. In Ontario, when air leaves the mine by a shaft, this structure is so inclosed that the air must travel to the top of the headframe; thus a motive column for ventilation is provided even when the terrain is flat. A case was illustrated where a high masonry stack was utilized to obtain more natural draft than could be afforded by a difference in depth of intake and return shafts. Seven or eight Ontario mines already are preheating the intake in winter.

Answering questions on the effect of lime (not limestone) dust for stemming in reducing the quantity of dust raised in blasting rock, Mr. Harrington said apparently lime had been found to make some improvement at the Mount Weather experimental mine, but the experience was not broad enough yet to justify conclusions. Whether reduction of dust might justify the firing of shots in non-gassy mines without stemming did not seem important, for where shots were arranged to fire after delays, the first shot might throw some of the other cartridges into the muck pile, if the holes in which they were embedded were not stemmed.

Answering a question, Mr. Gibson briefly described the work at the Porcupine Clinic, where a limited number of silicotics are being treated experimentally with metallic aluminum powder. Though it may be a year or more before the benefits could be assessed, the work, he said, was progressing favorably.

Necessity for the active participation of management in safety work was stressed at Tuesday afternoon's session by Mr. Henrie, who declared that safety work was commenced in 1913. At first a single safety inspector was engaged; later this was expanded into a safety department, but progress did not really get under way until safety committees were established.

Meetings of the department committees are held at least once a month, each of these covering a major department such as a mine or mill. These meetings are attended by all superintendents. Then there are shop and mine-division committee meetings which are attended by foremen, bosses and day's pay employees.

Protective Clothing Used

Eye, foot and head accidents comprised 28 per cent of all accidents, but these have been greatly curtailed by the use of protective clothing. One important improvement has been the introduction of duralumin crossbars which can be handled in longer lengths than steel units. In twelve months, the record of 222 accidents per year was reduced to 18 by this innovation. New men are instructed in informal talks by safety inspectors. Talks are given also at the noon hour. No bonuses are paid for safety records, there is no emotional appeal, and no safety rallies have been held. For attendance at safety meetings, hourly men get their regular pay, and other men are paid in accord with their earnings. The mines are not unionized.

At the National Gypsum Co. mines, said W. L. Jurden, safety director, union men are employed, and safety committees have been successfully introduced. The men are regularly rotated and no evidence of union politics has developed.

In the symposium on what an inspector should look for, C. A. Peterson spoke for anthracite mining and his article in abridgement appears on p. 58 of this issue. Too many inspectors develop hobbies or pet aversions which, once generally known, afford bosses and miners an opportunity to keep them busy on these while overlooking more important hazards, said J. L. Boardman, chairman, bureau of safety, Anaconda Cop-

Will Head Mining Section

Cadwallader Evans, vice-president and general manager, Hudson Coal Co., Scranton, Pa., general chairman; W. D. Haselton, Pickands-Mather Co., first vice-chairman; N. P. Rhinehart, chief, department of mines, West Virginia, second vice-chairman; John Treweek, Homestake Mining Co., third vice-chairman; Dan Harrington, U. S. Bureau of Mines, secretary. Committeemen not named.

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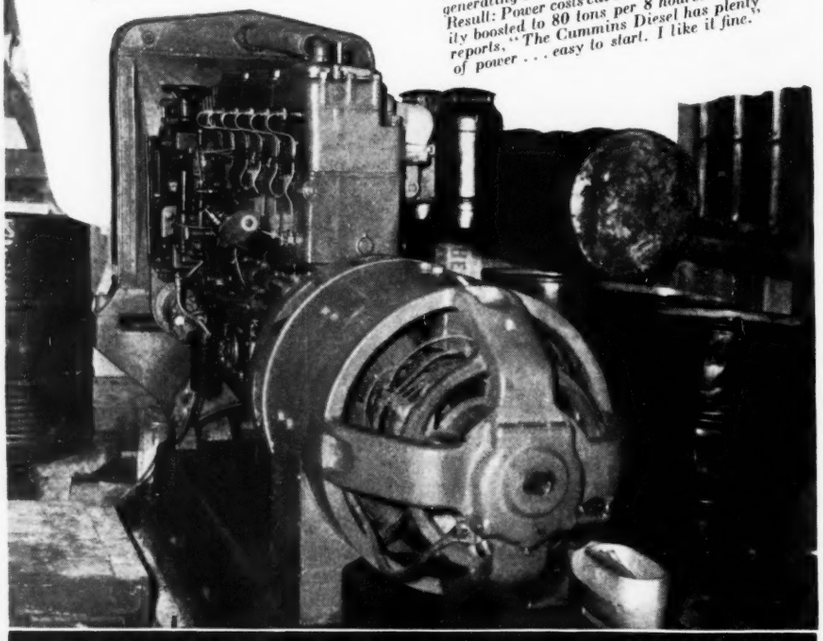

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per Mining Co. With one man this was hunting cachés of blasting caps and explosives in the gob and old timber. "What can happen will happen," he added, should be an inspector's axiom.

There are three E's in accident prevention —engineering, education and enforcement"— asserted J. Lindley, general inspector, Koppers Coal Co. Engineering he defined as the "application of common sense," covering not only physical improvement of the environment of the worker but the human element also.

A. A. Bauden, range safety inspector, Pickands, Mather & Co., described safety accomplishments during the past 25 years and in reply to Mr. Gibbs said that hard hats were supplied free; at first this free distribution was abused, but not now. The supply man is ordered to give a man a new hat if he (the supply man) thinks he should have one. Mr. Trestrail, another safety inspector for the company, said the practice of their division was to sell a $3 hat for $1. A man will not claim the right to buy a hat if it will cost him $1.

Urging the value of methane detectors, J. N. Zorn, safety engineer, Union Collieries Co., said that a ventilating current carrying 200,000 cu.ft. of air per minute, if it had only 0.1 per cent of methane, would carry out of the mine, minute by minute, 200 cu.ft. of that gas. It carries that quantity because the measures are bleeding it into the air every minute. In 24 hours, if the air ceased to carry it away from the mine because of a suspension of ventilation, the mine would contain 288,000 cu.ft. of methane mixed with its air.

Never Suspend Ventilation

Firedamp is explosive even when only 5 per cent of methane is present, hence methane is explosive when added to enough air to make the volume of the mixture twenty times as great as the volume of the methane; thus the methane present would make with air 5,760,000 cu.ft. of firedamp. This quantity would fill from end to end a heading with a cross-section 10 ft. square and 11 miles long. All of which proves that a mine that seems when ventilated to have a negligible quantity of methane—a mine safe in most men's language—will become extremely dangerous as soon as ventilation is suspended.

Provided that stirrable dust is present, 150 cu.ft. of methane mixed with air in suitable proportion will start an explosion of coal dust, urged Dan Harrington. Unfortunately, the younger men in the industry now attaining positions of trust have forgotten or ignored the lesson expensively taught by the series of explosions in the opening decade of the century.

Engineers are not happy even when they have a factor of safety of five, but, when 65 per cent of the dust in a heading is inert, the factor of safety is but 1½ to 2. Out of 61,000 mines, only 481 claim to use rock dust, and of these only about 10 per cent are rock-dusted adequately.

So much has been said about silicosis among miners that it is well to remember that more disability arises from other diseases if the total of disabilities from all these diseases is taken, declared R. R. Sayers, director, U. S. Bureau of Mines. Among the respiratory diseases of miners are bronchitis,

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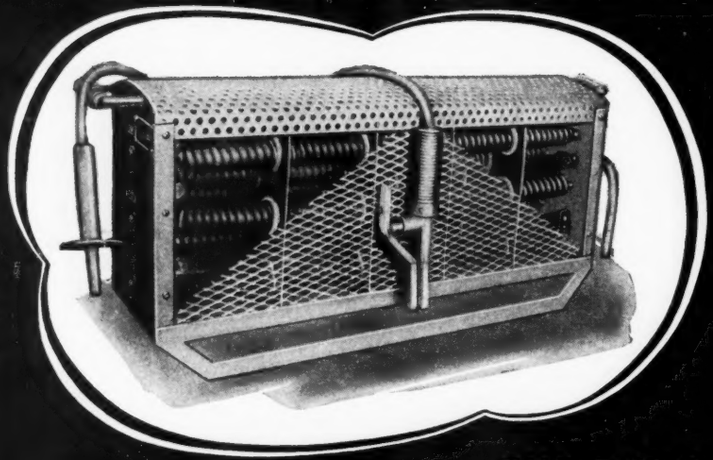

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influenza, pneumonia and tuberculosis. Bronchitis may arise from dust, especially siliceous dust. British figures for this disease show 136 deaths from this disease among those working in coal mines, as against 112 among those engaged in all industries and 50 in all occupied males when an equal number of males are concerned.

Dr. Sayers refused to define influenza but declared that apparently dust had something to do with its occurrence. Where the men are not exposed to dust, respiratory diseases are less frequent in mines than outside. Where there was dust, more men had "flu." Where the men in leaving a mine are subjected to a rapid change from a high to an excessively low temperature, the incidence of influenza will be greater.

Though Dr. Collis, the leading authority in Great Britain following Dr. Haldane, declared that miners were relatively free from tuberculosis, the Welsh National School of Medicine found it more prevalent among miners than among other males. Studies made by the U. S. Public Health Service revealed that 6 per cent of the hard-coal miners had "clinical pulmonary tuberculosis." The average prevalence of this disease in the United States is only 2 per cent. Presence of coal dust in the lungs of a miner modifies the effect of the tuberculosis and leads to a failure to recognize the disease as tuberculosis and causes its erroneous diagnosis as bronchitis. Of 27,011 persons tested in the anthracite region, 63 per cent had anthraco-silicosis.

But men should not be put out of the mine if they have that disease but be put to work where the dust content of the air is below the threshold at which it becomes harmful. No coal dust is extremely detrimental; its danger lies rather in the immense quantity frequently present. Yet here there is an advantage, for where there is much dust, the quantity can be the more readily reduced to a safe figure. Use of certain types of equipment creates ten times as much dust as loading by hand labor.

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Arkansas Preparation Plant Nears Completion

A preparation plant having a capacity of 2,000 tons per day and serving four mines is nearing completion at Hackett, Ark. Operators interested in the plant are: Excelsior Coal Co., George Reeves, president; Quality Excelsior Co., Isaac Lewis, president; E. H. Noel Coal Co., E. H. Noel, president; and Boyd Excelsior Coal Corporation, Robert Boyd, president.

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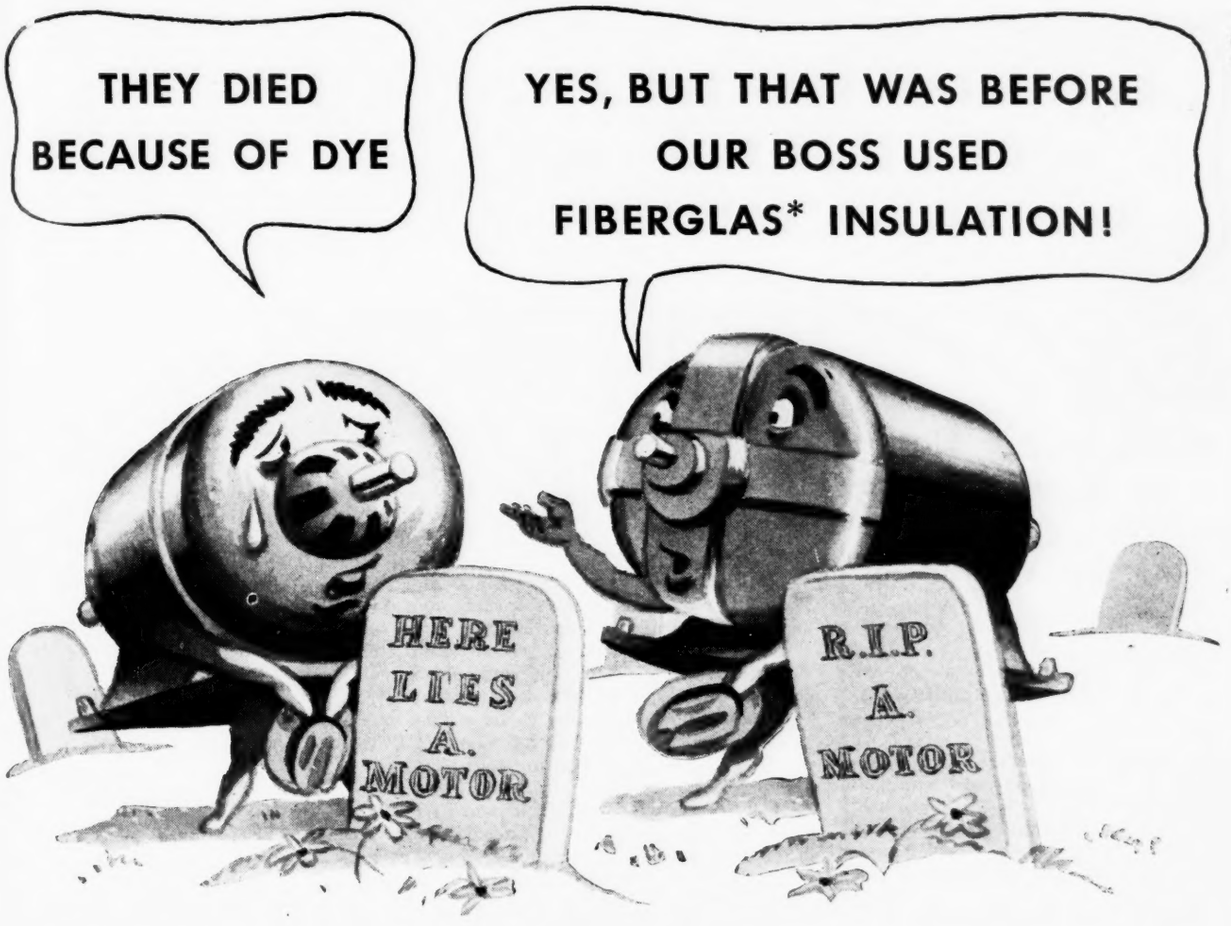
Mineral Industries Conference To Feature Dedication

A joint mineral industries conference will be held in connection with the dedication of the new Natural Resources Building of the Illinois Geological Survey, at Urbana-Champaign, Ill., Nov. 14 and 15. The conference is being sponsored by the Illinois Geological Survey, the Engineering Experiment Station of the University of Illinois, and the Illinois Mineral Industries Committee. The Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers



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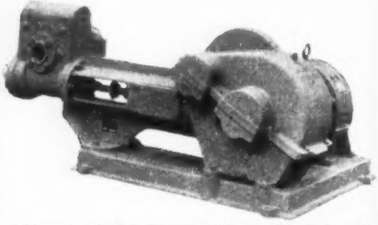

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will hold its fall meeting at Urbana at the same time.

Following an open-house gathering on the first day there will be an all-minerals industries luncheon. In the afternoon there will be separate sessions on coal, oil and gas, economies of industrial minerals and a symposium on the geology of the Devonian System. Sessions on the second day will be held on new developments in coal research, clay and ceramic products, rock and rock products, and the Devonian System. Dedication ceremonies of the Natural Resources Building will take place in the afternoon under the auspices of the State Board of Natural Resources and Conservation of the Department of Registration and Education, and the board of trustees of the University of Illinois.

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Coal Research and Preparation Problems Feature West Virginia Conference

SCREENING problems and losses in coal preparation, developments in the domestic- and industrial-fuel utilization fields, dustproofing of coal and research bearing on both the present and future of coal were the major subjects at a joint meeting of the West Virginia Coal Mining Institute, the West Virginia Coal Conference and the West Virginia Society of Professional Engineers, held at Morgantown, W. Va., Oct. 17-19. Other topics included the engineer's compensation, discussed by William S. Downs, West Virginia University; engineering education trends, by G. P. Boomsliter, West Virginia University; contributions of the oil and gas industry to West Virginia, by Paul H. Price, West Virginia State Geologist; and industrial West Virginia and national defense, by Ernest L. Bailey, State director, Office of Government Reports.

A feature of the proceedings was the ground-breaking ceremony for the new Mineral Industries Building to be erected at West Virginia University. The various speakers, including Governor Homer A. Holt, Charles E. Lawall, president, West Virginia University; Walter D. Thurmond, State Board of Control; and Arthur B. Koontz, University Board of Governors, stressed the fact that the added research facilities afforded by the new structure will be devoted in large part to the development of the coal and other mineral industries of the state. Research also was the keynote at the annual banquet, with Bennett Chapple, assistant to the president, American Rolling Mill Co., pointing out that the progress of the future depends upon the research of today. This belief, he stated, is behind research expenditures of $10,000,000 a year by the iron and steel industry, which consumes 3 tons of coal in manufacturing 1 ton of steel.

To Increase Facilities

Supplementing his remarks at the ground breaking, Prof. Lawall, at a later technical session, pointed out that the Mineral Industries Building, to be completed about Jan. 1, 1942, will provide much enlarged facilities for instruction and research by the School of Mines, the Department of Chemical Engineering, the University Geological Department and the West Virginia Geological Survey. In addition to laboratories devoted to coal preparation, analysis and scientific research, as well as work in affiliated fields, such as mineralogy, metallurgy and geology, the new building will include combustion laboratories, a ventilation laboratory and, in the basement, an "experimental mine," with the necessary ventilating equipment for large-scale studies of ventilating problems. The new building, declared Prof. Lawall, is designed to be the focal point of research in the State and is expected to greatly strengthen and expand such work.

Nothing is wrong with coal "that education, research and intelligent work cannot correct," contended D. L. McElroy, director, School of Mines, West Virginia University, in commenting on the part research will play in the future of the industry. Turning to specific subjects for investigation, Prof. McElroy pointed out that the School of Mines and the West Virginia College of Engineering already have completed work on conservation of natural gas, stresses in hoisting ropes, classification of gas wells for operation, mining methods, composition and byproduct values of West Virginia coals, control of ash fusion, electrical testing of mine roof, welded mine track, acid mine drainage and drainage of coal beds, mine haulage and the physical characteristics of West Virginia coals. In addition, work is now under way on roof control and subsidence, mechanical mining, the history of coal production in West Virginia, dustproofing of coal and gas-measurement instruments. Some 32 projects directly or indirectly relating to coal have been undertaken by the university's chemistry department, while the College of Agriculture has experi-

Coming Meetings

• Coal Division, American Institute of Mining and Metallurgical Engineers: fall meeting, held jointly with Fuels Division of American Society of Mechanical Engineers, Nov. 7-9, Hotel Tutweiler, Birmingham, Ala.

• Harlan County Coal Operators' Association: annual meeting, Nov. 20 (tentative), Harlan, Ky.

• American Society of Mechanical Engineers: annual meeting, Dec. 2-6, Hotel Astor, New York City.

• Coal Mining Institute of America: annual meeting Dec. 12 and 13, Fort Pitt Hotel, Pittsburgh, Pa.

• American Wood Preservers' Association: annual meeting, Jan. 28-30, 1941, Louisville, Ky.

• American Institute of Mining and Metallurgical Engineers: annual meeting, Feb. 17-20, 1941, Engineering Societies Building, New York City.

There's $$$ in answering the AEROSOL* Quiz!

1 What is AEROSOL OT?

It is a "wetting agent"—a substance which, when added to water, enables the latter to wet materials that otherwise could be wet only slowly or not at all.

2 What advantage is it to me?

Fine coal dust is hard to wet. AEROSOL OT is an aid in wetting coal dust in mines as it causes water to penetrate through dust masses and quickly wet all particles touched.

3 Why should I use it?

The U. S. Bureau of Mines (see I.C.7131) to lessen the coal dust explosion hazard, recommends: "To minimize the dilution of rock dust by freshly formed coal dust," . . .

a) Machine cuttings be wetted as the cutting is being done.

b) The coal face and the working place 40 feet therefrom shall be kept free of coal dust by the use of water.

c) The tops of loaded cars in the working place shall be wetted.

Similar dusty positions are:

d) The discharge end of conveyors

e) Rotary dumps

4 How do I use it?

Simply add one part AEROSOL OT to 500 to 1,000 parts of water to be used in wetting down coal dust. Use of this small amount will increase the wetting power of water manyfold.

5 How much equipment do I need?

Very little beyond the water supply, pump, and spray nozzles that are required for water alone. An ordinary watering can with a spray nozzle can be used for a trial application. Well known manufacturers have designed equipment for its use.

6 Will it increase my production cost?

Use of AEROSOL OT should *decrease* your production cost by:

1) decreasing the hazard of explosions from coal dust.

2) reducing manyfold the amount of water needed to wet the dust.

3) extending greatly the life of a given application of rock dust as proper wetting prevents scattering of coal dust which would otherwise mix with the rock dust

4) against these decreases, the amount of Aerosol added to 100 gallons of water costs only a few cents.

7 Where do I get it?

You can get AEROSOL OT from the American Cyanamid and Chemical Corp.

★ *"Trade-mark of American Cyanamid & Chemical Corporation applied to wetting agents of its own manufacture."*

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mented with coal and coal ash in soil control, in addition to work by other departments.

With the new Mineral Industries Building on its way, thought should be given to future studies for the benefit of the coal industry, said Prof. McElroy. A few of the more immediate problems, he stated, include: technical improvements in mining methods and equipment, ventilation problems in modern mining, diesel motive power for mine equipment, power usage, preparation improvements, development of new byproducts and improvement of old ones, theoretical and practical combustion studies, packaged fuel, and development of new fuel-burning equipment and improvement of old types, including the coal-burning stove still widely used as a heating medium.

Echoing Prof. McElroy's statement on the condition of the coal industry, W. E. E. Koepler, secretary, Pocahontas Operators' Association, pointed to investigations now under way, including stoker tests, coal-tar refining with catalytic agents, dustproofing, ash-fusion control, etc., and expressed the belief that too little attention has been paid to the utilization of coal in agriculture, either in growing, curing or processing crops. Other research possibilities include dustproofing, stokers and stoves, ash fusion, insecticides and fungicides, fertilizers and soil looseners, combustion design, preparation, grindability, pigments, plastics, preservatives, conservation in mining, hot-water heaters, pulverized and colloidal fuels, pipeline transportation, other transportation, processed fuels, including coke, briquets and boulets; packaged fuel, extrusion, roll and plunger presses, size consist, friability, microscopic and X-ray investigations, etc. "Suppose we had fellowships on half of these. Wouldn't we be getting somewhere?"

Research Aids the Nation

The foundations of our present civilization are built upon the results of scientific research as applied largely through agriculture and engineering to the natural resources of the nations, declared W. W. Hodge, department of chemical engineering, West Virginia University, in discussing some applications of research to West Virginia's natural resources. Among the more important of these resources are: clay, sand and stone, salt, coal, petroleum and natural gas. The industries which utilize these materials and have benefited materially from research include: ceramics, ferrous and non-ferrous metallurgy, chemicals and chemical engineering, the electrical industries in many respects, and the direct processing of coal in byproduct equipment. Coal also figures as a raw material in many of the other industries, as well as a fuel in manufacturing, processing and the like. And in addition to improvements in existing processes and products, research has developed many important new uses for the various natural resources, besides opening new avenues for the utilization of what once were considered waste products.

As an example of the value which can be added to a product by proper processing as a result of research work, Prof. Hodge called attention to byproduct coking, which years ago practically replaced the beehive oven, which wasted everything but the coke. In 1937, the total value of products per ton of coal coked was $5.85, whereas the average value of coal in that year was $1.95 per ton and of prepared sizes alone $2.37 per ton. Liquefaction of coal is a promising field and coal research in general is "very very necessary."

But scientific, industrial and engineering research, contended Prof. Hodge, should be complemented by research in economic, sociological and marketing fields, which, in the latest year for which data are available, received only $5,000,000 for its support, compared with $130,000,000 for chemical, physical and other purely scientific research; $180,000,000 for industrial and engineering research; and $57,000,000 for government projects. One objective should be elimination as far as possible of the ups and downs in the mining and manufacturing industries.

Institute Officers

W. G. Crichton, vice-president, Johnstown Coal & Coke Co., was elected president of the West Virginia Coal Mining Institute at its annual business session at Morgantown, W. Va., Oct. 19. Mr. Crichton succeeds Charles W. Connor, general superintendent, American Rolling Mill Co., Nellis, W. Va. Other officers and board members were chosen as follows:

Vice-Presidents — T. E. Johnson, Hutchinson Coal Co.; John Sydnor, West Virginia Coal & Coke Corporation; M. H. Forester, Consolidation Coal Co.; H. C. Faust, United Pocahontas Coal Co.; and Joseph Pursglove, Jr., Pursglove Coal Mining Co.

Secretary-Treasurer—D. L. McElroy, director, School of Mines, West Virginia University.

Executive Board—R. J. Burmeister, Raleigh Coal & Coke Co.; Carel Robinson; N. P. Rhinehart, chief, West Virginia Department of Mines; F. F. Jorgenson, Monongahela Rail & River Coal Corporation; and Mr. Connor.

Who Checks Coal Losses?

Even companies with elaborate accounting systems commonly make no check on the recovery of coal in their preparation plants, and thus, while keeping track of the mills, "are letting cents per ton of output slip away from them," observed Byron M. Bird, Battelle Memorial Institute, in discussing losses of coal in preparation. Inefficiency in washing is only one way of losing coal which could be sold, and probably in the average case such a loss is not the most important. "Let any . . . person answer these questions: Do you recover and sell your sludge? Do you crush and rewash middlings? Are you cleaning some sizes at a lower washing gravity than necessary and thus wasting salable coal? Are you cleaning only the coarse sizes and mixing dirty fine sizes of raw coal with the prepared sizes? These are some of the many ways in which coal may be lost in a cleaning plant."

After demonstrating by example the "principle of exchange," under which a loss in salable coal results, even though the shipped product has the ash content set up for the washing gravity use, due to the fact that some lower-gravity material which belongs in the washed coal goes into the refuse and some higher-gravity material belonging in the refuse goes into the washed coal, Mr. Bird then discussed the relationship of washing losses to float-and-sink data. "Such data do not give the true washing loss." However, they may be used in arriving at a first approximation to the washing loss by application of a factor developed at Battelle by averaging the results of a number of washing tests where both floats-and-sinks and true losses were known. "Our figures show that approximately 60 per cent of the loss in weight shown by float-and-sink tests of the refuse is true loss in weight."

Presenting a few rules and suggestions for arriving at true washery losses, Mr. Bird then turned to a discussion of some of the causes of such losses. "One, a most important cause, is poor adjustment of the washer. Another, the usual alibi for poor results, is overloading the washer. But in the average case, overloading has little meaning, for most washing equipment must be readjusted for high tonnages and, as that usually is not done, overloading is more often than not a question of poor judgment. But perhaps the most important one, and one that should be easy to correct, is pure neglect to keep the equipment operating efficiently." However, "sometimes the washers are inefficient and then the answer is a supplementary washing device to reclean the refuse."

Rewashing Beneficial

Such a supplementary washing unit naturally should produce a "marginal type of material that barely belongs in the washed coal." Accordingly, "sound reasoning would lead one to make a very high-ash product from a supplementary washing operation to add to the primary washed coal. When this is done it sometimes will be necessary to pull more refuse from the primary washer in order to lower the primary ash content of the washed coal somewhat. In other words, it will be necessary to remove most of the sink material in the primary washed coal in order that it may absorb a high-ash product from a rewash system without unduly raising the ash content of the final product."

Appearance usually is the deciding factor in the sale of domestic sizes, and consequently the coarse sizes normally must be cleaned at a relatively low specific gravity, resulting in a high percentage of reject containing considerable recoverable stratified materials that can be crushed and re-treated to advantage. How much in each case requires float-and-sink tests? "As a general working principle one can safely say that in any case where a coal requires a separation below 1.50 specific gravity, the company is losing a substantial percentage of recoverable coal if it is not crushing and re-treating middlings. . . . In the average washing operation at 1.45 specific gravity, a rewash system will recover coal worth $20 to $50 per day and about all that is required in the way of additional operating expense is the power to operate the washing unit."

Another source of losses at many opera-

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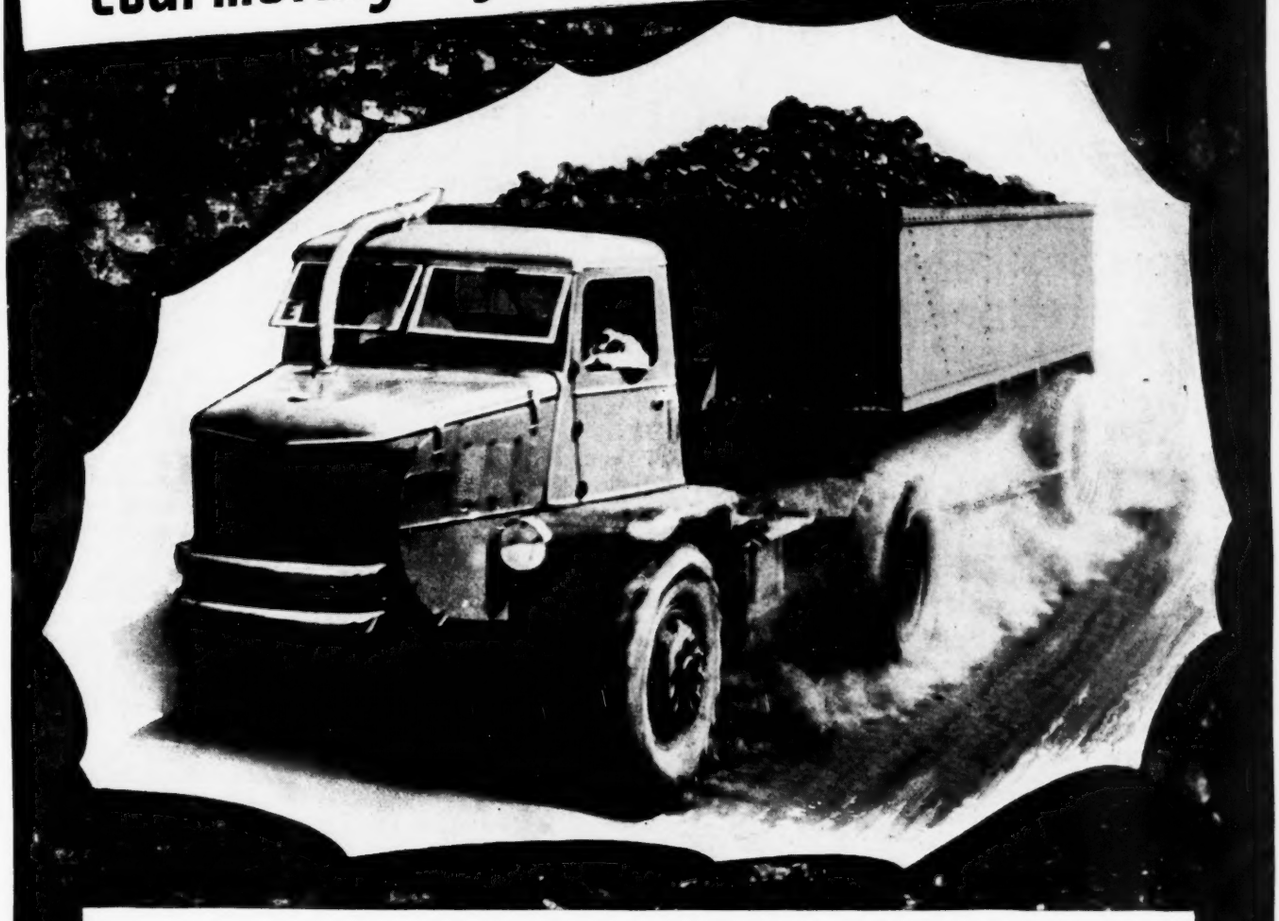

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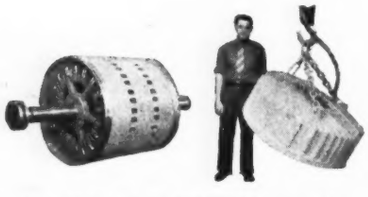

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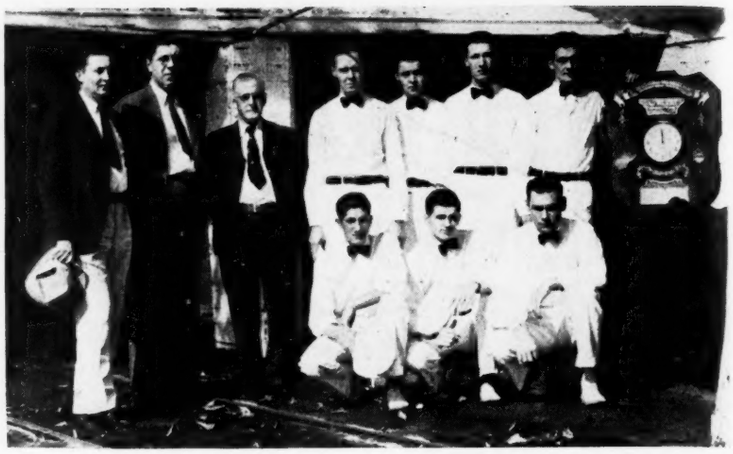

Koppers Stanaford Team, Winner of New River and Winding Gulf Safety Meet

Kneeling—Robert Scott, Dougal Smith and W. Saunders. Standing—Ira Amburgey, safety inspector; O. B. Clark, mine superintendent; John Lindley, chief safety inspector; Ira Hurt, James Campbell, John Scott and Earl Parker, captain. See *Coal Age*, October, 1949, p. 198.

tions is cleaning all sizes in one washer at the same washing gravity. If appearance makes a low-gravity separation desirable for the coarser sizes, "it follows that the smaller sizes are being washed at a lower-than-necessary specific gravity. . . . It is not at all uncommon to find $50 to $100 per day of recoverable coal being lost in this way even in a moderate-sized plant. In many cases, the only method of recovering small coal that has been washed at too low a gravity is to install an auxiliary washer to reclean the refuse. . . . However, to those who have jigging installations another alternative is open and that is to adjust the jig so that less cleaning is done on the fine sizes than on the coarse. This can be accomplished by using more water than is necessary," reducing the suction and automatically resulting in a higher-gravity separation of the fine sizes without effect on cleaning of the coarse sizes.

Washing coarse sizes and bypassing the fines, while it saves the cost of cleaning the fines by a dry method or drying them if washed, results in a loss of merchantable coal. The fine sizes usually contain more or less high-ash impurities and in order to have the washed coal absorb these impurities when the fines are mixed back it is necessary to clean the coarse sizes to a comparatively low ash. Thus a loss of good coarse coal usually is the result, the volume of such loss determining how much supplementary cleaning the company can afford to do.

Loss of coal in the sludge "is the most controversial of all, for many companies assert that they cannot market sludge at a profit, particularly sludge high in sulphur or lacking in coking properties. I am not prepared to answer these statements in all cases," declared Mr. Bird, "but I see a definite improvement in the market for fine coal, and my judgment is that it could be sold at a profit if the coal companies really thought so."

Screening of bituminous coal "is of more vital interest today than at any previous time in the history of the industry," said G. R. Delamater, W. S. Tyler Co., in referring to a recent study of sizes and grades by the Bituminous Coal Division, Department of the Interior. Shaker screens have always dominated the bituminous tipple because, first, no effort was made for many years to screen below 1¼-, 1- or ¾-in. round holes, and, second, because such screens lend themselves very nicely to conveying and distribution of sizes. They also require a minimum of headroom. "The high percentage of slack coal plus falling slack prices created a desire for finer-mesh screenings." which found the shaker inefficient under normal conditions of surface moisture. Consequently vibrating screens of many types have been developed and make it possible to screen down to 28-mesh without drying of the coal. Oil and gas competition stimulated the development of the coal stoker, but it "was soon found that the fine dust resulted in many mechanical difficulties and dedusting at from 48- to 10-mesh has become almost universal."

Surface moisture largely determines the minimum separation which can be made efficiently on shaker screens, "and usually separations below 1¼-in. now are made on mechanically vibrated screens," which also have been installed for separations up to 6-in., round hole, "thus replacing shakers where conditions are suitable." The minimum size separation possible with mechanically vibrated screens, "depends entirely upon the surface-moisture content of the coal." Many installations operate at as small as 10-mesh, but where the surface moisture is high, separation may have to stop at ¼-in. or even larger. "For separation beyond the low limit of mechanically vibrated screens the electrically vibrated screen is required, and for separations below 10-mesh an electrically vibrated screen with impact has been found an absolute necessity."

Observing that long-stroke vibration tends to throw dust coal off the cloth, Mr. Delamater recommended that in fine-mesh screening of high-surface-moisture coal the screens be operated at a steep pitch of 36

to 38 deg. for commercially profitable capacity while maintaining a thin bed on the screen so that fine dust can be whipped through the cloth before it has a chance to pack.

"Screening capacity is contingent upon many things but mainly is largely dependent upon: (1) surface moisture content of the coal, (2) screen analysis of the feed—more particularly the percentage of sizes close to the opening of the cloth to be used in the screening operation; (3) screening efficiency required and (4) inclination of the screen." A satisfactory method of determining a surface moisture is to spread the coal to a depth of 1 to 1½ in. in a shallow pan of the proper size and air- or heat-dry until no surface moisture is noticeable when stirred or can be seen upon the bottom of the pan. The loss in weight will give the surface moisture which affects screen capacity. The quantity of sizes near the separation size should be closely studied, as it will affect the speed of separation and consequently the capacity of the screen. Desired efficiency also is a factor, as a screen to operate at 80 to 85 per cent efficiency obviously can be fed at a higher rate than one operating at 95 per cent.

"Our electrically vibrated screens all are designed to operate at steep inclinations—32 to 38 deg.—dependent upon the conditions to be met. Our mechanically vibrated screens can be operated horizontally if desired, uphill if necessary, as in dewatering, or may be inclined at any desired angle in the direction of the flow of material." However, "it is our custom to recommend an inclined rather than a horizontal screen" to keep operating and maintenance costs to a minimum, "but where headroom is of great importance we have no objection to installing our mechanically vibrated screens in a horizontal position."

Wet Coal Sizing

Little wet screening is done in the bituminous industry, but, if done, best results are obtained by first mixing the coal with water and feeding a fluid mixture to the screen. "This usually results in 90 to 95 per cent of the undersize passing through the screen mesh with the water in the first 2 to 3 ft. of length. Water sprays then can be used, if necessary, to clean out as much as possible of the remaining undersize," although, as pressure sprays tend to drive near-size particles tightly into the mesh, with consequent serious blinding, "their use should be avoided if at all possible. It is not good practice to attempt to wet-screen coal and dewater it on the same unit." A separate dewatering screen should be employed for maximum efficiency.

"Horizontal or uphill screens are best for dewatering coal." Wedge-wire, which has been extensively used on high-speed shaker or reciprocating dewatering screens, has not been found satisfactory on vibrating screens because of difficulty in holding the wedge-wire deck in place. And since wedge wire is expensive, the usual tendency is to keep it in service far beyond the point where it should have been removed because of slot enlargement. Furthermore, wedge wire now is difficult to get. "As a result, stainless-steel Ton-Cap facing cloth stretched tightly over a suitable backing cloth has come into extensive use and many report a

De Laval Worm Gear driving Jeffrey car loading conveyor for the Barnes Coal Co.

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have been adopted by the most-prominent builders of mining machinery. They know that in addition to giving satisfactory performance, De Laval gears have back of them a leading maker of the highest grade speed reducers, with a well established reputation for making good.

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Charles W. Connor, retiring institute president, poses for the Coal Age camera.

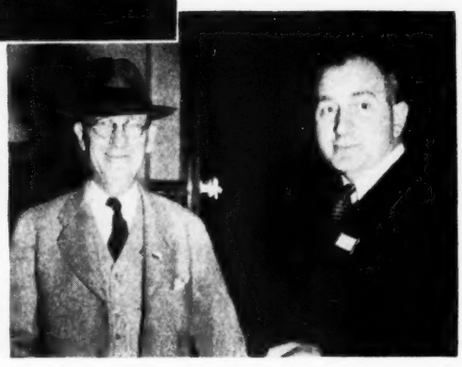
After-meeting confab, with S. D. Brady Jr., consulting engineer; T. E. Johnson, Hutchinson Coal Co., and Samuel Pursglove Sr., Pursglove Coal Mining Co., talking things over.

Speakers Delamater and Bird converse with D. L. Sibray, Koppers Coal Co.

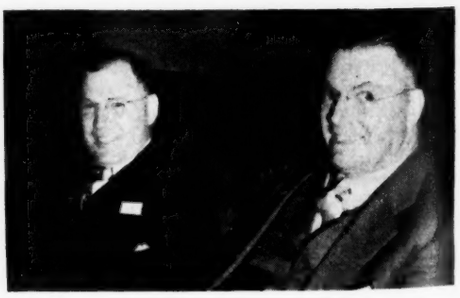
Part of the ground-breaking ceremonies for the new Mineral Industries Building at West Virginia University. President Charles E. Lawall is introducing Governor Holt. Coal men seated in the front row are Brooks Fleming Jr., Consolidation Coal Co.; J. V. Sullivan, S. C. Higgins and W. E. E. Koepler.

Pre-session line-up, with Reed Scollon, fellow, West Virginia University; J. V. Sullivan, West Virginia Coal Association; W. E. E. Koepler, Pocahontas Operators' Association, and D. L. McElroy, director, School of Mines, on the rostrum.

Awaiting the bell. C. E. Lesher, Pittsburgh Coal Carbonization Co., and E. G. Bailey, Babcock & Wilcox Co., await speaking turns.



S. C. Higgins, secretary, New River Coal Operators' Association, exudes a broad smile during a pause in his conversation with L. I. Cothern, Virginia Polytechnic Institute.



Set for the meeting are N. C. Raeder and Roy C. Baker, Kelleys Creek Colliery Co.

dewatering efficiency at least equal to wedge wire with coal losses from widening of the openings entirely eliminated.

Square-mesh cloth "assures accurate screening but has a tendency to blind," said Mr. Delamater. "Weaves with a length of opening about double the width greatly overcome that difficulty and cloth now has been developed in which the length of opening is from 2 to 5 in., depending upon the combination of opening width and wire diameter. Such cloth has made possible some fine-mesh separations that could be accomplished in no other way."

"Keeping the American people warm is a large undertaking and involves several huge industries," averred C. E. Lesher, president, Pittsburgh Coal Carbonization Co. Steadily rising standards of living over the years have called for more comfort, meaning more heat, more equipment and more fuel. Oil and gas have played a large part in promoting this increase, "for they first gave us automatic, convenient heating of homes. For a long time there was no comparable offering by coal, although anthracite was making a strong bid to hold the luxury heating field.

Table I—Estimated Tons Annual Coal Consumption of Equipment Sold During Years Specified

Year	Steam Boilers	Kilns, Furnaces and Ovens	Stokers, Class 5, 1201 Lb. per Hr. and Over for All Power Boilers	Stokers* Class 1, 20 to 60; Class 2, 61 to 100; Class 3, 101 to 300; Class 4, 301 to 1,200 Lb. per Hr. Cap.	Coal Equivalent of Oil- and Gas-Fired New Water-Tube Power Boilers
1931	1,620,000	112,000	2,549,000	.....	.....
1932	887,000	6,000	1,953,000	640,000	.....
1933	2,065,000	75,000	2,106,000	978,000	.....
1934	1,280,000	118,000	2,816,000	1,283,000	.....
1935	2,255,000	505,000	2,955,000	1,696,000	.....
1936	8,350,000	1,280,000	4,234,000	2,650,900	4,920,000
1937	6,760,000	520,000	3,918,000	3,244,000	3,090,000
1938	2,954,000	296,000	2,343,000	2,721,000	3,760,000
1939	6,700,000	625,000	4,313,000	3,025,000	2,820,000
1940†	7,960,000	350,000	3,272,000	3,400,000	4,040,000
Total	40,831,000	3,887,000	30,459,000	22,877,000	18,630,000

* K. C. Richmond, *Coal Heat*, September, 1939, plus later Dept. of Commerce data.
† Estimated data.

Solid Fuels Field

"What are the fuels with which we keep warm? They are the solid fuels, such as anthracite, bituminous coal and coke made from it; the manufactured, as briquets and petroleum coke; the liquid, oil; and the piped fuel, gas. In terms of coal or its equivalent, the annual domestic heating load is roughly as follows: anthracite, 47,000,000 tons; coke (1936 peak), 12,000,000; bituminous coal, 70,000,000; briquets, packaged fuel, 1,000,000; oil, 20,000,000 tons (coal equivalent); and gas 20,000,000 tons (coal equivalent). Of this total, "I estimate" that 30,000,000 families use 150,000,000 tons of coal or its equivalent per year, with the remaining 20,000,000 tons consumed in heating buildings, institutions, hotels, theaters, etc. Some 38,000 retail dealers handle "our estimated total of 130,000,000 tons of solid fuel," and as a large city may have over a thousand such dealers against a single gas distributor, "it will be apparent at once what this means to the solid-fuel industry in developing public relations and merchandising its product.

"We have been accustomed to speak of the demand for coal as inelastic—that is, as dependent upon the pace of industry and the state of the weather." However, a revolution in fuel consumption has taken place since 1920, with engineering and technical progress reducing consumption by industry on the one hand while, on the other, "the per capita consumption of coal for domestic heating has increased. Many are the reasons for this, but I think the most important is that people are really keeping warm. . . . Gas and oil burners were the first to attempt the automatic heating job. . . . Now coal is going automatic too."

The Committee of Ten is authority for the estimate that there are about 550,000 stokers of all types in use, 90 per cent classed as household sizes, against 540,000 gas-fuel furnaces and 1,900,000 oil burners in homes. "We may thus say that 3,000,000 homes are equipped with automatic heat out of 30,000,000 in the country." Saturation of the automatic heating market is a long way off. "But after automatic heating has done its best and all who can and many who can't afford them have stokers there will remain an overwhelming majority of homes that will be hand-fired with solid fuel."

Households equipped with hand-fired equipment burn anthracite, coke and the various grades of bituminous coal and lignite. "Each kind has it advantages." Also available for solid-fuel firing are petroleum coke, briquets and packaged fuel made from coal and coke screenings, in addition to low-temperature, or semi-, coke, which "has the ease of ignition of soft coal and the cleanliness in use of anthracite and coke." "Disco" is an example of such a product, which can be described as "soft coal with the smoke taken out." The cost of heating by hand-firing and automatic equipment with various fuels is indicated by the results of work done by the Battelle Memorial Institute, which showed the following costs for a definite heating job: coke, $93; semi-bituminous coal, $94.90; bituminous coal, $97.87; stoker-fired bituminous coal, $116,25. natural gas (at Columbus), $147.85; oil, $173.65.

"The point is that hand-firing yields the lowest cost and that the manufactured fuel, coke, at a higher cost per ton delivered, gave the lowest over-all cost. The future of hand-fired fuel is not dimmed by automatic heating. With proper fuel it is the best for the long pull." Many gains are to be made in "economy, convenience and cleanliness for the big majority who hand-fire their fuel. This field is hardly touched."

In addition to keeping warm there is the growing problem of smoke. "The hand-fired solid-fuel industry has yet to meet the challenge of smoke-conscious communities. Carbonization of coal is the only proved method of taking the smoke out of soft coal," and "the next forward movement in coal carbonization will get its impetus from the demand for smokeless hand-fired fuel and the pressure for an economic use for the undersized fine coals resulting from double-screening stoker sizes."

Coal sizing came about to meet the demands of the domestic and other markets for screened coal, said E. G. Bailey, Babcock & Wilcox Co., in opening his discussion of trends in coal preparation and burning equipment. Improvements in stokers and development of small domestic units have added greatly to the demand for coal screened between relatively narrow limits. In the long run, coal must be prepared to meet the needs of the coal-burning equipment, "much of which is so far from being perfected that coal of special quality and preparation must be supplied for its satisfactory operation," adding to preparation cost and providing a better opportunity for oil and gas competition. "The ideal furnace and fuel-burning equipment is that which will efficiently burn coal of any rank or grade or quality with a minimum of variation in over-all cost."

The conventional coal-burning locomotive most nearly complies with this condition, even though efficiency is low because of the necessary concentration of the power plant. However, the limitations of the coal-burning locomotive should not be overlooked and progress must be made to meet the expanding competition of the diesel-electric locomotive, which presents its most convincing arguments in two fields—switching (12,436,508 tons of coal in 1939) and passenger (15,291,189 tons).

Coal-Burning Trends

Another coal market now completely gone to oil is the U. S. Navy and many passenger and merchant ships, although many ocean-going cargo vessels remain, along with the Great Lakes fleet. However, improvements in methods of generating steam on these ships should receive careful study to head off the possibility of further conversions to oil.

The cement industry furnishes an outstanding example of standardization on the most economical fuel, with pulverized coal the choice except in a few sections where oil and natural gas have undisputed advantages. An outstanding change in the industry is feeding coal directly to the pulverizer and burner without drying, thus eliminating fussy preparation and widening the range of coals which may be employed.

In public-utility electric-power generation, the trend is toward higher temperatures and steam outputs. Industrial power plants also are growing in size in some cases, although there still are many small plants where power is not a large item in the finished-product cost and convenience plays a larger part, often leading to the selection of gas or oil as the fuel. Heating of homes and buildings finds convenience a major item and oil and gas competition consequently much stronger.

Estimated consumption of coal in various types of industries, as summarized by Mr.

Bailey, with comments on the sources of the data, is given in Table I. One fact is that about 50 per cent of all steam generated from power boilers purchased in the past five years is from pulverized coal. Dry-ash removal prevails almost exclusively in boiler furnaces rated at less than 250,000 lb. of steam per hour; larger installations are predominantly of the slag-tap type.

"The definite trend toward pulverized coal in boiler units larger than 500 hp. not only will have a decided influence on the preparation and sizing of coal but with the advantages of slag-tap furnaces in the larger units much coal can be readily burned which has an ash-fusion temperature too low for best stoker operation. . . . Coals with ash-fluid temperatures as high as 2,700 deg. F. are being successfully burned in slag-tap furnaces." Also, "progress in developing pulverized coal-fired furnaces has been carried to the point where any coal with a low-fusing-temperature ash can be satisfactorily burned in dry-ash furnaces."

Further, "improvements have been and are being made in stokers. Furnace walls often are partially or completely water-cooled and some of the larger stokers also are water-cooled to some extent. It must be acknowledged, however, that there always is going to be problems with fuel beds which are not met with in the cases of fuels burned in suspension, like oil, gas and pulverized coal."

Coal's Greatest Market

While research in the bituminous industry has been largely directed toward new uses, Mr. Bailey reminded his listeners that "the greatest possible market has been and probably always will be for fuel." The best way to meet competition is deliver the heat in coal into the steam pipe as simply and cheaply as possible. "If coal were a uniform product in rank and quality—that is, if we had only one uniform kind of coal to deal with—the progress toward a perfect method of burning it would have been more quickly successful. It is the diversity which has bothered the stoker and equipment manufacturers. They have tried to develop equipment for one coal and then extend its use to other kinds beyond which it was best adapted. The coal producer has tried to modify his product by cleaning and sizing to better adapt it to a given equipment type. The best answer seems to be to develop and improve equipment to burn a wide range of coals efficiently and thereby minimize the problem of coal selection and preparation."

"Dustproofing now is widely accepted as the solution to the problem of making coal a really clean fuel," declared Reed Scollon, research fellow, West Virginia University. "The potential market for dustproofed coal is many times greater than the actual market and is continually growing at a terrific rate. . . . Dustproofing generally is defined as the process by which a substance is rendered substantially dust-free until used. This is accomplished by mechanical dedusting or by agents which hold the dust to the larger particles and prevent it from escaping to the surroundings. The latter method is the more popular.

"An ideal dustproofing agent should effectively and permanently allay dust, have no deleterious effects on coal-handling or burning equipment, should not hinder in any way the combustion of the coal, and should be inexpensive. In addition, it should be odorless and smokeless and should not freeze or affect the fusion point of the ash. Needless to say, nothing has been found to meet all of these specifications. Therefore, the individual producer is confronted with the problem of selecting the dustproofing agent which best suits his particular needs."

Discussing the various types of treating materials used, including oils and calcium chloride, Mr. Scollon pointed out that the second major problem for the individual coal producer "is the determination of quantities, viscosities or concentrations of the treating material selected, while the third is the best method of applying the dustproofing agent. The cost of the material and its application are the controlling factors in the solution of these three problems. The present customary charge of 10c. per ton for dustless treatment does not permit the use of expensive agents and elaborate application systems."

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Rolla Business and Industrial Conference Marks Extracurricular Activities

EXTRACURRICULAR instruction of the student was the primary purpose of the Second Business and Industrial Conference at Missouri School of Mines and Metallurgy, Rolla, on Sept. 27. The meeting was again under the direction of M. D. Orten, professor of economics, and its theme was "The Engineer and the Future."

Under the chairmanship of C. R. Forbes, professor of mining, the morning session was opened by William R. Chedsey, director of M.S.M. He pointed out that the engineer differs from the technologist, technician and scientist in that he must make an economic application of science.

That we are getting soft and need toughening in order to meet the hurricane threatening human freedom and democratic forms of government was pointed out by Wilbur B. Jones, chairman of the board of directors of the St. Louis Chamber of Commerce. Even though the principal mineral regions of this country, he continued, have been found, the job of the young engineer is to find new resources and ways to use them.

Walter W. Head, president of the General American Life Insurance Co., St. Louis, deplored the lowering of American morale brought about by depression and unemployment. He emphasized that we must again learn to work and build rather than exist by means of a dole system.

"We would do well to straighten out our own home in place of continuously condemning the other fellow," declared Arthur Casey, director of public relations, Columbia Broadcasting System, St. Louis. He opened the afternoon session, which was under the chairmanship of G. A. Muilenberg, professor of geology.

"Debunk the economic theories under which we live today," advised Dr. Gaston DuBois, vice-president, Monsanto Chemical Co., St. Louis. Young men, he thought, should be prepared to fight and to take risks; so should the country. Our forefathers, he continued, didn't come here for security but for freedom. Artificial security without taking risks will not succeed. He pointed out that there were plenty of opportunities in the chemical industry as well as in many others, particularly in developments for utilization of waste by-products. "In spite of the limitations of our geographical frontiers," said he, "opportunities for expansion and for creation of greater national security are better than ever." Science and industry can and must, with encouragement from the government, put the unemployed back to work, but there must be logical thinking, not only emotional or political thinking.

Dr. DuBois attacked the question of whether America has reached a stage of maturity which would preclude further great expansion and development. It has been much discussed lately and also for the past 100 years, said he, and during this

William R. Chedsey, C. R. Forbes, Dr. Gaston DuBois, R. R. Tucker and M. D. Orten enjoy an after-dinner chat.

period chemical development has grown to be a two billion dollar industry that employs about a million men. And that is only part of the story, as this industry has profoundly affected others.

Attended by businessmen, students and faculty, the evening banquet was guided by toastmaster Dr. Enoch Ray Needles, New York City. Chief speaker R. R. Tucker, smoke commissioner, discussed the St. Louis smoke ordinance, pointing out its justification and the harmful affects caused by deposits of carbon, tar, ash, ammonia compounds and sulphur acids of smoke in non-enforcement of such ordinances.

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Personal Notes

WILLIAM CRAWFORD has been promoted from superintendent of No. 7 mine of the Island Creek Coal Co., Holden, W. Va., to general superintendent of the new mines of the Marianna Smokeless Coal Co., Wyoming County, West Virginia.

W. C. GILL, vice-president, Lake Erie Mining Co., was reelected president of the Coal Producers' Association of Illinois at its annual meeting, Oct. 8, at Springfield. Others reelected are: vice-president, B. H. FIRTH, Lumaghi Coal Co., and secretary treasurer, GLENN A. SHAFER.

RALPH HODGSON, mine foreman at the Huber colliery of the Glen Alden Coal Co., Ashley, Pa., has been transferred to the Wanamie colliery, Wanamie, Pa., where he will serve in a similar capacity.

DAVID JOSEPH, superintendent of the Wanamie colliery of the Glen Alden Coal Co., Wanamie, Pa., has been transferred to the Truesdale colliery, Nanticoke, Pa., to act in the same capacity.

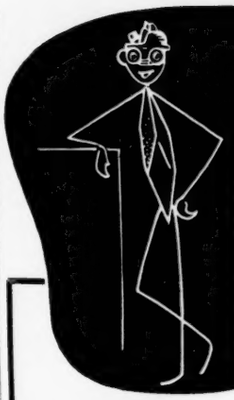
WALTER J. KELLY has been appointed acting manager of the industrial relations department of the Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., vice J. F. VANCE, retired. JOHN M. WILLIAMSON has been named acting assistant manager.

FRED KLIPPLE, mine foreman at the Wanamie colliery of the Glen Alden Coal Co., Wanamie, Pa., has been promoted to superintendent at that operation.

A. A. LOWE has been promoted from night foreman to general mine foreman, Freeburn mine, Leckie Collieries Co., Aflex, Ky. He succeeds R. H. MULKY, who is now superintendent of the Borderland Collieries Co., Borderland, W. Va.

RICHARD J. LUND, editor of *Mining Congress Journal*, has been appointed assistant group executive in the Mining and Mineral Products Division of the Advisory Commission to the Council of National Defense. His duties will pertain particularly to coordination of work relating to a wide variety of minerals—both metals and non-metals—in the defense program.

JAMES J. MCSHERRY, director of Mines and Minerals in the State of Illinois, tendered his resignation on Oct. 11 to Governor John Stelle, who succeeded to the governorship on the demise of Governor Horner. It was indicated at the chief execu-



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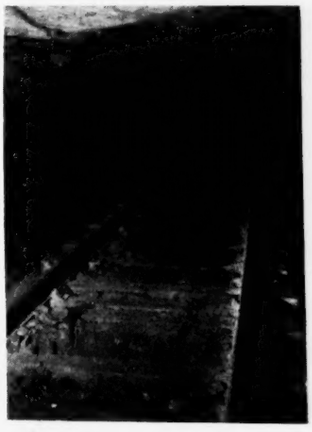

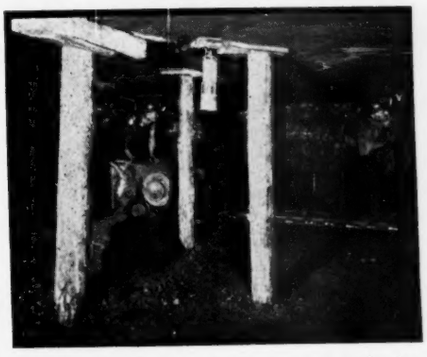

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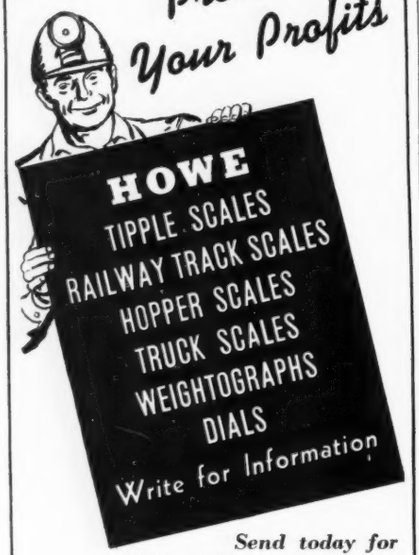

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tive's office that the resignation would not be accepted.

GEORGE H. SOWERS has been appointed Commissioner of Smoke Prevention and Abatement in Kansas City, Mo.

BEN WILLIAMSON, JR., manager of the Ashland (Ky.) office of the Bituminous Coal Division since it was organized, several years ago, has tendered his resignation to Secretary of the Interior Ickes, citing press of his own business as his reason for resigning.

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Illinois Mining Electric Group Observes Third Birthday

Southern Illinois Mining Electric Group celebrated the third anniversary of its founding on Oct. 4 at the West Frankfort Country Club, West Frankfort, with open house for its women friends. Besides serving a cafeteria lunch the association provided bingo and a movie. The movie showed an auto caravan across Africa, featuring native celebrations, sandstorms and wild animals at home. The film was furnished by Chrysler; Dodge trucks and a Dodge sedan made up the travel equipment in the caravan. The projector and sound equipment were furnished by Westinghouse.

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Colonel O'Toole Passes

Col. Edward O'Toole, 74, formerly of Gary, W. Va., and famous as a pioneer in the coal industry, died Oct. 2 at Coral Gables, Fla., after a brief illness. Getting his first experience in the mines at the age of nine, he held at various times practically every position connected with coal mining. Active in the industry in West Virginia for two score years, he organized and developed a number of companies, including the Central Pocahontas Coal Co., Crystal Block Mining Co., Tug River Electric Co. and Kentucky River Power Co.

He directed the development of the coal mines of the United States Steel Corporation in West Virginia and Kentucky and was, in addition, an inventor of mining machinery. Among his devices were the O'Toole-Jeffrey overcutting machine and the O'Toole cutting and loading machine. He also developed the dry cleaning process for the American Coal Cleaning Corporation.

Rice Miller

Rice Miller Is Dead

Rice Miller, 62, prominent in the coal industry of Illinois more than a quarter century, died suddenly Oct. 16 of a heart attack at his home in Hillsboro, Ill. A law graduate at Cornell University, he took up legal practice in Hillsboro, was city attorney for two years, and then joined the Hillsboro Coal Co., becoming its general manager in 1901, and being still its executive head at the time of his death.

He was vice-president of the Illinois Coal Operators' Association, 1916–20, and president, 1920–28; served as chairman of the joint interstate wage conference in Miami, 1927; and had several terms on the State Mining Investigating Commission, being elected chairman in 1929. Between times he found time to serve as Mayor of Hillsboro for two terms and as president of that town's board of education.

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New Preparation Facilities

BERWIND-WHITE COAL MINING CO., Maryland Shaft, St. Michael, Pa.: Contract closed with Heyl & Patterson, Inc., for lump-coal handling and crushing equipment, including 36x48-in. two-roll crusher; capacity, 120

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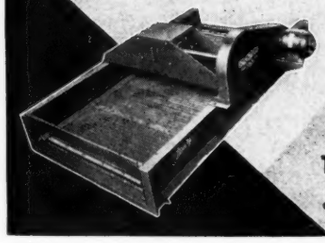

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t.p.h. 6- to ¾-in. coal; expected to be completed Nov. 15.

Clifford Bressler, Pine Grove, Pa.: Contract closed with Deister Concentrator Co. for one SuperDuty No. 7 diagonal-deck washing table to handle 0x¼-in. coal; capacity, about 14 tons feed per hour.

W. G. Duncan Coal Co., Inc., Luzerne, Ky.: Contract closed with Jeffrey Mfg. Co. for Jeffrey unit washery composed of a diaphragm jig, dewatering screen and clarifying tank, designed to wash 50 t.p.h. of 0x1-in. coal; addition to existing plant.

Eastern Coal Corporation, Mines 1 and 11, Hardy, Ky.: Contract closed with Morrow Mfg. Co. for crushing and rescreening plant, equipment to consist of conveyors, vibrating screens, crusher, etc.; capacity, 270 t.p.h. of 0x2-in. coal; to be completed about Nov. 15.

Evans Coal Co., Beaver Meadows, Pa.: Contract closed with Deister Concentrator Co. for one SuperDuty diagonal-deck washing table to treat No. 1 buckwheat anthracite; capacity, 18 to 20 tons of washed coal per hour.

Hudson Coal Co., Marvine Breaker, Scranton, Pa.: Contract closed with Chance Coal Cleaner for installation of four 8x8-ft. Chance cones to prepare rice and barley coal; combined capacity, 300 t.p.h. of raw coal; Staples & Sweeney Mfg. Co. is furnishing material and labor and expects to have the job completed about Dec. 15.

Hydrotated Anthracite Fuel Co., Inc., Lattimer Mines, Pa.: Contract closed with Wilmot Engineering Co. for complete breaker to reclaim anthracite silt for industrial use; equipment to include one Wilmot Hydrotator to clean coal. Selectro screens for sizing and dewatering, and Keystone rivetless chain conveyors; capacity, 75 t.p.h. of feed.

Imperial Smokeless Coal Co., Imperial Mine, Quinwood, W. Va.: Contract closed with Fuel Process Co. for stove coal washer; capacity, 50 t.p.h.; to be completed Nov. 1.

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Permissible Plates Issued

Seven approvals of permissible equipment were issued by the U. S. Bureau of Mines in September, as follows:

Western Electric Co.: Model 10A magnetic telephone; Approval 902; Sept. 3.

Western Electric Co.: Model 11A magnetic telephone; Approval 903; Sept. 3.

Jeffrey Mfg. Co.: Class 34 distribution box, three branch circuits; 250 and 500 volts, d.c.; Approvals 412 and 412A; Sept. 12.

Mine Safety Appliances Co.: M.S.A. alarm-type methane detector; Approval 807; Sept. 13.

Joy Mfg. Co.: Type 14-BU 3-hp. loading machine; four 7½-hp. and one 4-hp. motor, 250 volts, d.c.; Approval 413; Sept. 23.

LaBour Co., Inc.: No. 10 DSM pump; 3-hp. motor, 250 volts, d.c.; Approval 414; Sept. 23.

Koehler Mfg. Co.: Wheat Model CM electric cap lamp; Approval 28; Sept. 28.

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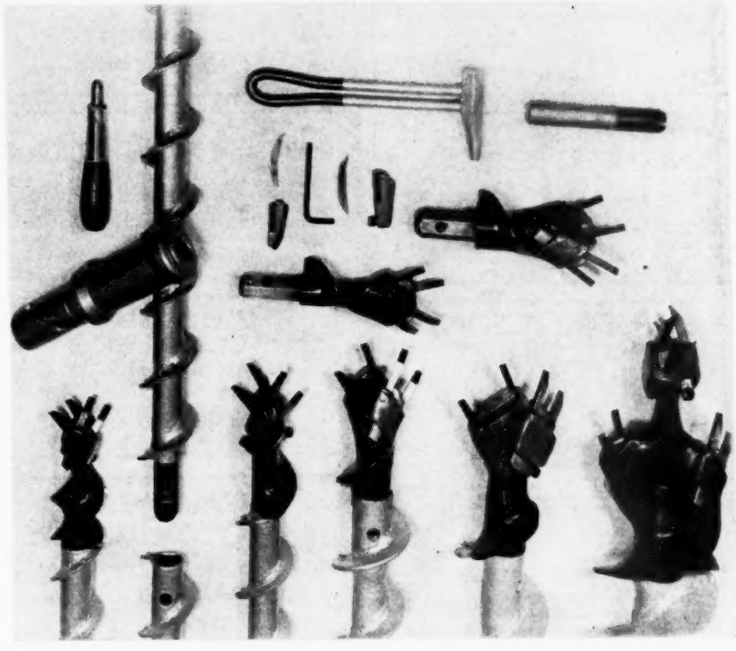

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Of Coal Age, published monthly at Albany, N. Y., for October 1, 1940.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared D. C. McGraw, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Coal Age, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. Editor, Sydney A. Hale, 330 West 42nd St., N. Y. C. Managing Editor, Walter M. Dake, 330 West 42nd St., N. Y. C. Business Manager, H. W. Clarke, 330 West 42nd St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. Stockholders of which are: James H. McGraw, 330 West 42nd St., N. Y. C. James H. McGraw, Jr., 330 West 42nd St., N. Y. C. James H. McGraw, James H. McGraw, Jr., and Curtis W. McGraw, Trustees for: Harold W. McGraw, James H. McGraw, Jr., Donald C. McGraw, Curtis W. McGraw: Curtis W. McGraw, 330 West 42nd St., N. Y. C. Donald C. McGraw, 330 West 42nd St., N. Y. C. Anne Hugus Britton, 330 West 42nd St., N. Y. C. Mildred W. McGraw, Madison, N. J. Grace W. Mehren, 73 No. Country Club Drive, Phoenix, Ariz. J. Malcolm Muir & Guaranty Trust Co. of New York, Trustees for Lida Kelly Muir, 140 Broadway, N. Y. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is. (This information is required from daily publications only.)

D. C. McGRAW, Secretary.

McGRAW-HILL PUBLISHING COMPANY, INC.
Sworn to and subscribed before me this 27th day of September, 1940.
[SEAL] H. E. BEIRNE,
Notary Public, Nassau County. Clk's No. 93. N. Y. Clk's No. 974, Reg. No. 2-B-609.
(My commission expires March 30, 1942)

Pittston, Pa.: Contract closed with Deister Concentrator Co. for one SuperDuty No. 7 diagonal-deck Deister-Overstrom washing table to handle rice anthracite; capacity about 18 tons of washed coal per hour.

LILLYBROOK COAL CO., Lillybrook, W. Va.: Contract closed with Fuel Process Co. for pea coal washer; capacity, 50 t.p.h.; to be completed about Nov. 1.

LOCUST COAL CO., Weston Colliery, Shenandoah, Pa.: Contract closed with Deister Concentrator Co. for one 4x7-ft. double-surface Leahy NO-Blind vibrating screen to screen out No. 4 buckwheat, with capacity of 20 tons per hour; also for four No. 7 SuperDuty diagonal-deck washing tables to treat Nos. 1, 2 and 3 buckwheat, with capacity of 12 tons of washed coal per hour; also one No. 7 SuperDuty diagonal-deck washing table to treat No. 4 buckwheat; capacity, 10 tons treated coal per hour.

MORGAN COAL CO., Old Forge Breaker, Old Forge, Pa.: Contract closed with Finch Mfg. Co. for one 8-ft. Menzies cone separator to clean stove and chestnut coal; feed capacity, 70 tons per hour.

NORTHWESTERN IMPROVEMENT CO., Roslyn, Wash.: Contract closed with Deister Concentrator Co. for one No. 7 SuperDuty diagonal-deck washing table to handle 0x¼-in. coal; capacity, about 14 tons feed per hour.

PARIS COAL WASHERY CO., INC., Paris, Ark.: Contract closed with Deister Concentrator Co. for two 4x7-ft. Leahy heavy-duty NO-Blind vibrating screens equipped with Concenco water sprays; two SuperDuty No. 7 diagonal-deck Deister-Overstrom tables to treat 0x⅜-in. coal, with capacity of about 15 tons feed per hour; also two SuperDuty No. 7 diagonal-deck Deister-Overstrom washing tables, one to treat ⅜x2-in. coal (capacity, 15 to 18 tons feed per hour), the other to treat 2x3-in. coal (capacity, 16 to 20 tons feed per hour).

PERU DEEP VEIN COAL CO., Peru, Ill.: Contract closed with Deister Concentrator Co. for one SuperDuty diagonal-deck washing table to handle 0x1¼-in. coal; plant capacity, 15 tons feed per hour.

POTTSVILLE COAL CO., Port Carbon, Pa.: Contract closed with Deister Concentrator Co. for one No. 7 SuperDuty diagonal-deck washing table to treat No. 4 buckwheat; capacity, 18 tons washed coal per hour.

REPUBLIC STEEL CORPORATION, Sayreton, Ala.: Contract closed with Deister Concentrator Co. for four SuperDuty No. 7 diagonal-deck washing tables and one Concenco four-way-split revolving feed distributor; feed to consist of bony jig middlings; capacity, about 40 tons feed per hour.

SULLIVAN TRAIL COAL CO., Sullivan Trail Breaker, West Pittston, Pa.; Contract closed with Finch Mfg. Co. for one 3-ft. Menzies cone separator to clean No. 4 buckwheat coal (capacity, 12 tons per hour); also one 4-ft. Menzies cone separator to clean barley coal (feed capacity, 22 tons per hour).

SUNNYSIDE COAL CO., Cumberland, Md.: Contract closed with Deister Concentrator Co. for one No. 7 SuperDuty diagonal-deck washing table to handle 0x1¼-in. coal; capacity, 12 to 16 tons feed per hour.

TENNESSEE CONSOLIDATED COAL CO., Palmer, Tenn.: Contract closed with Deister Concentrator Co. for one SuperDuty No. 7 diagonal-deck washing table to handle

$\frac{3}{4}$x$\frac{3}{8}$-in. coal; capacity, about 16 tons feed per hour.

RAYMOND A. WREN, Williamstown, Pa.: Contract closed with Deister Concentrator Co. for two SuperDuty No. 7 diagonal-deck washing tables to treat No. 7 buckwheat; capacity, 36 tons washed coal per hour.

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New Lincoln Award Program For Welding Studies

Four hundred fifty-eight awards totaling $200,000 are offered by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, for papers judged worthy of award which report advances and improvements made between Jan. 1, 1940, and June 1, 1942 by application of arc welding to design, manufacture, fabrication, construction, welding service or maintenance. The foundation points out that in addition to the cash prizes the industrial progress program offers a special opportunity for engineers, designers, architects, draftsmen, officials of production, construction and maintenance to gain prestige, recognition and advancement.

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Obituary

JOSEPH GORDON, 43, president and general manager of the Buck Run Colliery Co., Pottsville, Pa., died Sept. 30 at Good Samaritan Hospital, in that city. He had been stricken with a heart attack early in the afternoon of the same day. He was associated with the Tony Rose mining interests, taking over the Buck Run operation a year ago.

JOHN S. MCKEEVER, 69, vice-president, Riverton Coal Co., operating at Crown Hill, in Kanawha County, W. Va., died suddenly Oct. 7 of a heart attack. For many years until January, 1938, he was general superintendent of mines of the Kanawha & Hocking Coal & Coke Co.

DAVID LLOYD, 71, well-known independent anthracite operator, died Oct. 13 at his home near Scranton, Pa. Coming to this country from Wales as a child, he started work at the age of eight as a breaker boy, working up until he became district superintendent of the Glen Alden Coal Co. He left this company in 1919 to organize the Slocum Hollow Coal Co., later formed the Park Hill and Lincoln coal companies, and in 1925 acquired the Green Ridge Coal Co. Seven years later he took over the Dial Rock Coal Co. At his death he was president of the two last named companies.

GEORGE A. ENOS, 54, president of the Enos Coal Mining Co., with operations in Oakland City, Ind., and office in Cleveland, died Oct. 18 in St. Luke's Hospital, Cleveland, after an illness of three months. He began his business career as an employee of the New York Central R. R., organizing the coal company in 1920.

BENEDICT SHUBART, 64, widely known coal-equipment engineer, one of the founders of the firm of Lindrooth & Shubart, later Shubart & Schloss, of Denver, Colo., died Sept. 30 at La Jolla, Calif., following a long illness. He had been active in the affairs of the Rocky Mountain Coal Mining Institute and for a time was its president.

H. H. TIMKEN SR., chairman of the board, Timken Roller Bearing Co., died Oct. 14 at his home in Canton, Ohio, of pneumonia, which developed from chronic asthma. He attended St. Louis public schools, Washington University, and the University of California, from which he was graduated with a law degree. He practiced law for a while in San Diego, but soon joined his father in the carriage and wagon-making business. Beginnnig as a day laborer, he worked from the bottom up, becoming a foreman, then a department head and, finally, factory manager. Shortly after this his father perfected the principle of the Timken tapered roller bearing. Within a short time bearings and axles formed the bulk of Timken production.

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Industrial Notes

CARBOLOY, INC., Detroit, Mich., has appointed W. C. Weslow as manager of its mining division. Since going with Carboloy from the Ross Mfg. Co., in 1931, he has been field and development engineer in connection with diamond impregnated tools.

HENRY J. MCKENZIE, heretofore executive vice-president and general manager of the Sterling Pump Corporation, Hamilton, Ohio, has been appointed president to succeed Maurice Rothschild, who will continue as a director. Mr. McKenzie will retain his post as general manager.

GENERAL ELECTRIC CO., Schenectady, N. Y., has been given top award in the machinery and appliance group of the fifth annual modern plastics competition, sponsored by *Modern Plastics* magazine. The award was made for a molded Textolite contactor shaft submitted in the contest.

JOHN A. ROEBLING'S SONS CO., Trenton, N. J., has appointed Roger H. Clapp as assistant general manager of sales with headquarters in Trenton. Formerly with American Steel & Wire Co. for fourteen years, then with the Wickwire Spencer Steel Co. for thirteen years, Mr. Clapp joined Roeblings in 1936, becoming manager of the Philadelphia branch, where he remained until the present change. Earl N. Graf, former manager of the Pittsburgh branch, has been named assistant manager of sales, wire rope division, also with headquarters at Trenton.

ALLEN-SHERMAN-HOFF CO., Philadelphia, Pa., pump manufacturer, has opened a New York office at 271 Madison Ave., with B. C. Berry and P. D. Oesterle in charge.

BABCOCK & WILCOX TUBE CO. has transferred Harvey Wilson, formerly in charge of its Philadelphia sales office, to the New York office and placed him in charge as district sales manager. He also will have jurisdiction over the Philadelphia office, to which R. M. Lackner has been transferred from the Detroit office. B. F. W. Seaburn has been placed in charge of the Detroit office, having been transferred from the district sales office at Beaver Falls, Pa.

LINK-BELT CO., Chicago, has made George S. Jaxon manager of the company's activities in Eastern coal fields, with headquarters in Pittsburgh. Associated with the company since 1915, Mr. Jaxon was in charge of coal-preparation-plant design and estimating at

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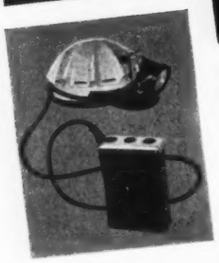

Portable's CAP LAMP Can CUT COSTS...

INCREASE PRODUCTION

1. Portable's Lamp is the brightest approved lamp on the market today. Its brighter, steadier beam will help your men to work better and faster.

2. Portable's headpiece enables miners to adjust beam direction without tilting hats to uncomfortable and unsafe angles.

3. Portable's battery is the only one on the market backed by guarantee that it will never drop to less than 80% of capacity.

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5. Portable's 12 month contract, under which Portable's Cap Lamps are distributed, carries the most inclusive service clauses ever known to the industry.

Find out how Portable's Lamp can increase production and safety in your mine. Write for full information.

Portable Lamp & Equipment Co.
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TIME TO PREPARE
for preparing
PREMIUM Stoker Coal

Erecting a "Pennsylvania" BRADMILL for preparing PREMIUM Stoker coal.

Tests made in 3 different types, leading to selection of equipment for preparing 1¼"x⅛" Domestic Stoker coal, indicated approx. 22%, and 16% minus ⅛" from two types, with varying amounts of oversize, while the BRADMILL test showed less than 9% ⅛" and *no* oversize.

With more than $1.00 differential between Stoker coal, and the ⅛" fines, savings show early amortization of the investment made in the BRADMILL.

On receipt of your Stoker Coal specifications, we will be glad to make recommendations and quotation on indicated equipment.

Ask for Bulletin 8001

PENNSYLVANIA CRUSHER COMPANY

Liberty Trust Bldg. Philadelphia

Representatives in principal centers

Philadelphia until 1919, then district sales manager, with headquarters in Huntington, W. Va. Since 1932 he has headed up sales in this line with headquarters in Chicago.

LOUIS J. OTT, Ohio Brass Co., Mansfield, Ohio, has been elected a vice-president of the National Industrial Advertisers' Association.

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Dewatering Warrior River Mine

Warrior River mine of the Brookside-Pratt Mining Co., Carbon Hill, Ala., is being dewatered and is expected to be in operation again by mid-December. Water broke into the mine suddenly in February last and rapidly submerged pumps, transformers and all other equipment in the workings. A 3,500-g.p.m. Peerless pump has been placed in the mine to get rid of the water so that equipment can be repaired or new units installed where necessary.

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Alabama Gets Long Conveyor

The largest coal conveyor in Alabama is to be constructed by the Continental Gin Co., Birmingham, Ala., for the Alabama Power Co.'s Chickasaw steam plant, near Mobile, according to an announcement by G. H. Cole, purchasing agent for the power company. Equipped with one-third of a mile of belting, the $20,000 conveyor will be able to carry 200 tons of coal per hour from railroad cars and barges to the plant. The belting will be made at the Gadsden plant of the Goodyear Tire & Rubber Co. The new 40,000-kw. steam plant is to be completed early next year.

Mine Inspectors' Institute To Broaden Membership

The Mine Inspectors' Institute of America, which in its earlier years restricted its membership closely to mine inspectors, with possibly the founder, James T. Beard, as sole exception, is now seeking to extend its services to the coal industry and offering membership to safety engineers and all workers engaged in the inspection of mines or teaching safety practices.

Each mining company, the institute believes, could with advantage carry one or two of its staff on membership in the institute. The secretary is C. A. McDowell, 915 Brookline Boulevard, Pittsburgh, Pa.

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Coal-Mine Accident Fatality Rate Registers Recession

Accidents at coal mines of the United States caused the deaths of 74 bituminous and 10 anthracite miners in August last, according to reports furnished the U. S. Bureau of Mines by State mine inspectors. With a production of 39,240,000 net tons, the accident death rate among bituminous miners was 1.89 per million tons, compared with 2.17 in August, 1939.

The anthracite fatality rate in August last was 2.64, based on an output of 3,790,000 tons, against 4.43 in August, 1939.

For the two industries combined, the accident fatality rate in August last was 1.95, compared with 2.39 in the eighth month of the year previous.

Fatalities during August last, by causes and States, as well as comparable rates for the first eight months of 1939 and 1940 were:

UNITED STATES COAL-MINE FATALITIES IN AUGUST, 1940, BY CAUSES AND STATES

	Underground									Opencut and Surface					
State	Fall of Roof	Falls of Face	Haulage	Gas or Dust Explosions	Explosives	Electricity	Machinery	Mine Fires	Total Underground	Shaft	Falls of persons	Electricity	Other Causes	Total Surface	Grand Total
Alabama	3	..	2	1	..	..	..	..	6	..	..	..	..	..	6
Arkansas	..	..	..	10	..	..	..	..	10	..	..	..	..	..	10
Colorado	..	..	..	2	..	..	..	..	2	..	..	..	..	..	2
Illinois	6	..	1	..	1	..	..	..	8	..	..	..	..	..	8
Indiana	2	..	1	..	..	..	..	..	3	..	..	..	1	1	4
Kentucky	6	..	1	..	1	1	..	..	9	..	..	1	..	1	10
New Mexico	1	..	..	..	..	..	..	..	1	..	..	..	..	..	1
Ohio	1	..	1	..	1	1	..	..	4	..	..	..	..	..	4
Pennsylvania (bit.)	8	1	..	..	..	..	..	..	9	..	..	..	..	..	9
Tennessee	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1
Virginia	3	..	2	..	..	1	..	..	6	..	..	..	..	..	6
West Virginia	8	..	2	..	..	1	..	..	11	1	..	..	..	..	12
Wyoming	..	..	..	..	..	..	..	1	1	..	..	..	..	..	1
Total (bituminous)	38	1	10	13	3	4	..	1	70	1	..	1	2	3	74
Pennsylvania (anthracite)	6	..	1	1	..	..	1	..	9	..	1	..	..	1	10
Grand total	44	1	11	14	3	4	1	1	79	1	1	1	2	4	84

FATALITIES AND DEATH RATES AT UNITED STATES COAL MINES, BY CAUSES*

January–August, 1939 and 1940

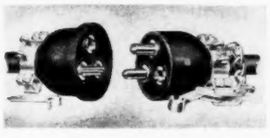
	Bituminous				Anthracite				Total			
	Number Killed		Killed per Million Tons		Number Killed		Killed per Million Tons		Number Killed		Killed per Million Tons	
Underground:	1939	1940	1939	1940	1939	1940	1939	1940	1939	1940	1939	1940
Falls of roof and coal	281	329	1.348	1.114	76	65	2.247	1.957	357	394	1.378	1.200
Haulage	83	120	.368	.406	17	25	.502	.753	100	145	3.86	.441
Gas or dust explosions:												
Local	6	12	.027	.040	3	3	.089	.090	9	15	.035	.046
Major	28	236	.124	.799	....	...	.....	.....	28	236	.108	.718
Explosives	6	17	.027	.058	13	5	.384	.151	19	22	.073	.067
Electricity	26	20	.115	.068	2	5	.059	.151	28	25	.108	.076
Machinery	19	17	.084	.058	1	2	.030	.060	20	19	.077	.058
Shaft	4	2	.018	.007	4	3	.118	.090	8	5	.031	.015
Miscellaneous	11	19	.049	.064	9	3	.266	.090	20	22	.077	.067
Stripping or opencut	4	6	.018	.020	4	2	.118	.060	8	8	.031	.024
Surface	19	27	.084	.092	12	6	.355	.181	31	33	.120	.160
Grand total	487	805	2.162	2.726	141	119	4.168	3.583	628	924	2.424	2.812

*All figures subject to revision.

WHAT'S NEW IN COAL-MINING EQUIPMENT

THREE-CONDUCTOR RUBBER CABLE CONNECTOR

Ohio Brass Co., Mansfield, Ohio, announces the development of a three-conductor plug-type rubber cable connector, known as the O-B Mechano-Plug, especially designed for connecting devices. It will accommodate No. 2 and smaller sizes of two- or three-conductor insulated cable. The entire unit is rubber-covered, with overlapping joints for exclusion of



dust and moisture. Exterior surfaces are rounded and smooth so that the device may be dragged along the bottom or floor without catching.

The outstanding feature of the device is its ease of installation in the field. The copper strand is easily and quickly inserted into plugs and receptacles and locked into permanent position by means of steel setscrews. Phosphor-bronze plugs in the male half of the connector, split to give a spring-tight fit, are arranged so that they can be inserted in the female body only in the proper position, thus safeguarding connection procedure. A chain-lock arrangement makes it impossible to disconnect the device inadvertently.

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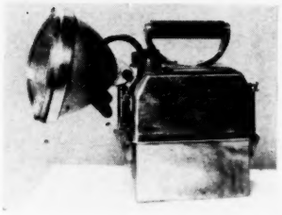
EMERGENCY LAMP

A light for locations where there is no electric current available or where it is hazardous to introduce long power-extension cords is offered by the Stewart R. Browne Mfg. Co., New York City. In case of power failure, operating independently of all power circuits, this storage-battery emergency lamp, identified as Model SB 100, can, according to the manufacturer, be used for light until normal service can be restored.

All of the joints between the two parts of the battery case, the lamp and the lens holder, the



case and the cord of this lamp are sealed and, together with a vaporproof switch, are said to insure positive protection against ignition of explosive gases or vapors. A special laminated and shatterproof lens, strong enough to resist even a severe blow, protects the light bulb. A second refractor lens, which more uniformly diffuses the beam, is mounted in the same holder with the shatterproof lens and adds to its lighting efficiency.

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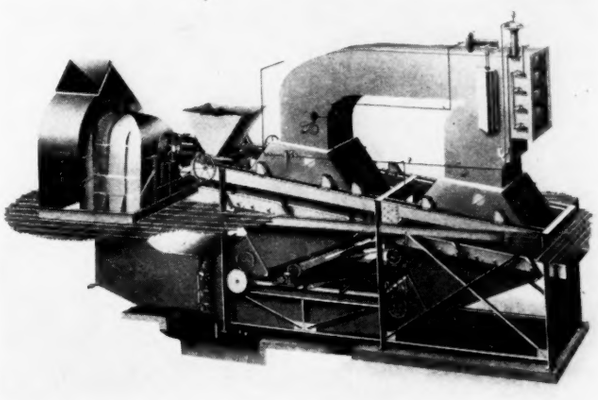
COAL DRYER

The McNally-Pittsburg Mfg. Corporation, Chicago and Pittsburg, Kan., has redesigned the McNally-Vissac coal dryer. In this unit, hot gases tempered with atmospheric air are drawn at high pressure through wet coal as it advances on a reciprocating screen. Moisture evaporation is accompanied by mechanical dewatering and quantities approaching 50 per cent of the total moisture have been removed mechanically. Great savings in fuel and furnace requirements are claimed and complete drying of the product is obtained at a lower temperature. Suction packing or matting of the fine wet coal is prevented by the patented pulsator, which breaks the hot-gas column into pressure cycles and this enables the coal to progress along the screen by relieving pressure at regular intervals. Provision also is made for cooling the dried product before it leaves the dryer.



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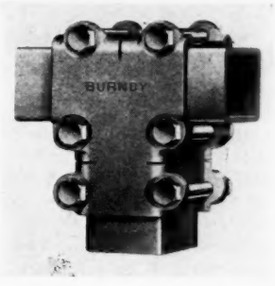
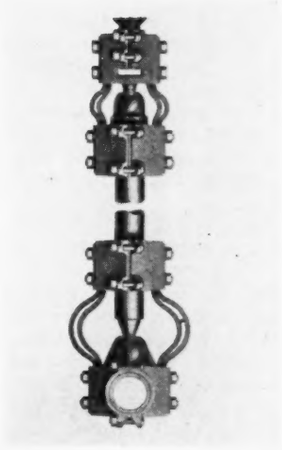
ELECTRICAL CONNECTORS

A complete line of electrical connectors and bus supports for square tubular buses, both ventilated and unventilated types, is announced by Burndy Engineering Co., Inc., New York City. Clamping pressure is exerted on the corners of the tube and



thereby buckling of the tube walls is prevented.

Types XTBS and XDBS connectors are designed to permit expansion or contraction of a tap conductor at any angle to the overhead bus or transformer stud. They will "warp" with the substation but will not flop about loosely, says the manufacturer.



At the same time, it adds, they will preserve all the advantages of rigid construction. They are said to provide a completely universal joint with ball-and-socket alignment guides incorporated in both stud connector and flexible T-connector. They are designed to accommodate all sizes of tubular conductors.

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PREPARATION PROCESS FOR ANTHRACITE

A new method of anthracite coal preparation, described as increasing efficiency and economy of operation, has been developed by minerals separation specialists of E. I. duPont de Nemours & Co., Inc., Wilmington, Del. The equipment employed is a single-unit multiple-stage classifier containing ten individual hydraulic columns and two rotating zoners.

Designed specifically for the production of Nos. 2, 3, 4 and 5 buckwheat sizes, the device will clean feeds ranging from closely sized materials to a comparatively broad-size range such as mixtures of rice and barley or Nos. 4 and 5 buck. The feed may be variable in composition, its source being either fresh run-of-mine or a silt bank.

Uniform quality may be obtained consistently after initial adjustments, officials said, and uniform conditions in the machine may be maintained automatically. Operating costs and power and water requirements

are described as extremely low. One attendant can supervise a complete unit. A low-ash product and a high-ash refuse may be obtained from presized or mixed feeds, it was said. Two products may be produced simultaneously from a mixed feed of two sizes.

Recovery of salable coal and the machine's capacity depend on the quality of feed. Performance may be defined accurately from tests of the feed materials to determine hydraulic characteristics. Accurate separations at a high yield and high rate may be made with either square-fractured coal and square-fractured refuse, flat coal and flat refuse, or flat coal and square-fractured refuse.

The operating circuit is simple, DuPont officials explained. For the production of rice or barley sizes, the feed, either mixed or separate, passes from the sizing screens over a shaking feeder to the machine. Four overflow products are delivered to a four-lane screen for dewatering and removal of small classified refuse. The hydraulic columns of the machine are distributed around its circumference and the zoners, fitted with fins, carry material from column to column without disturbing classification. The zoners rotate separately at low speeds, one moving at a faster rate than the other.

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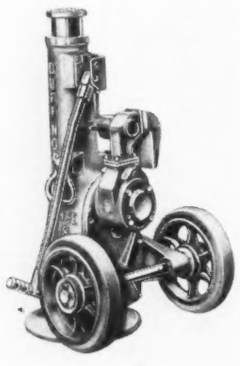
ROTARY AIR MOTOR JACK

Announcement of a new 20-ton rotary air motor jack is made by the Duff-Norton Mfg. Co., Pittsburgh, Pa. Rounding out a line of five sizes, the new jack is very speedy, effecting a time and labor saving of 88 per cent, according to the company.

Readily adaptable to many and varied industrial uses, the jack is mounted on rubber-tired roller-bearing wheels and is easy to move and place. The accurately timed lift permits one man to operate two jacks through a "Y" valve connection with a quick, even raise to its limit of 18 in. When the lifting standard reaches the safe limit of raised or lowered position, the motor is automatically cut off.



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EXCAVATOR

Thew Shovel Co., Lorain, Ohio, offers a new 1¼-yd. excavator featuring vacuum control. Known as the Lorain-69, this model is available with a complete line of interchangeable boom equipment as a shovel, dragline, 18-ton crane, backdigger and skimmer scoop.

The revolving turntable features simplicity of construction, ability to concentrate full engine power directly when and where needed, flexibility to spread properly balanced power over two or three simultaneous and synchronized operations.

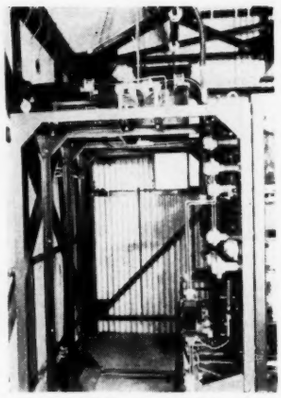
The swing clutches, crowd and retract travel clutches, and the crowd brake are all vacuum controlled. The method used is the "vacuum-plus-air" booster type, designed as a "closed" system. The turntable is mounted on a center "chain" drive crawler, 12 ft. 9 in. long and 10 ft. 2 in. wide when equipped with standard 24-in. treads. The crawler is propelled at two travel speeds: 1½ and ¾ m.p.h. The shovel boom is 21 ft. long from pin to pin and is equipped with 36-in.-diameter boom peak sheaves and 18-ft. dipper stick.

•

CONVERTER SWITCHBOARD

New automatic switchboards built by the I-T-E Circuit Breaker Co., Philadelphia, for control of rotary converters have features which adapt them to semi-portable as well as permanent station service. Each of three panels comprising an upper 48-in. section and a lower 28-in. section is individually mounted on its own free-standing framework. No sills, wall braces or other supports are required and the complete switchboard is assembled in any convenient location by fastening the three frames together with a few bolts.

Each panel is wired in the rear to right- and left-hand terminal boards and may be mounted therefore in any desired combination with the d.c. panel to either right or left of the a.c. starting and running circuit breakers. Thus the switchboard is said to be ideally adapted for quick relocation to maintain the adequate voltage so necessary with mechanical mining. Separate panels are trucked to the new location with a minimum of inconvenience and loss of time.



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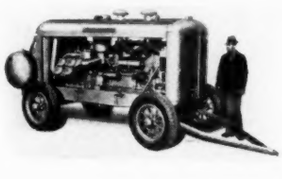
TAPPER

Black & Decker Mfg. Co., Towson, Md., has added the Tapgun to its line of high-speed production tools. The new unit weighs only 3¾ lb., measures 9¼ in. over all, taps up to $\frac{5}{16}$-in. cast iron, $\frac{3}{16}$-in. steel, and $\frac{3}{8}$-in. brass or aluminum. It taps at 400 r.p.m. and backs out at 525 r.p.m. This tool augments the No. 22 Tapper, which has been in the line for some years and which is a heavier tool for greater capacity.

•

PORTABLE COMPRESSOR

A new portable compressor delivering 500 cu.ft. per minute (actual) at 100 lb. pressure is announced by Ingersoll-Rand Co., Philipsburg, N. J. Known as the K-500, this machine is now the largest in the company's line of two-stage air-cooled units; it weighs 10,600 lb. Features of the new unit include: choice of either an oil engine or a new-type six-cylinder gasoline engine which does not require high-grade motor gasoline, replaceable cylinder liners for engines, and a patented automatic fuel saver which changes the engine speed according to the use of compressed air. The unit can be had with either wheel or skid mounting.



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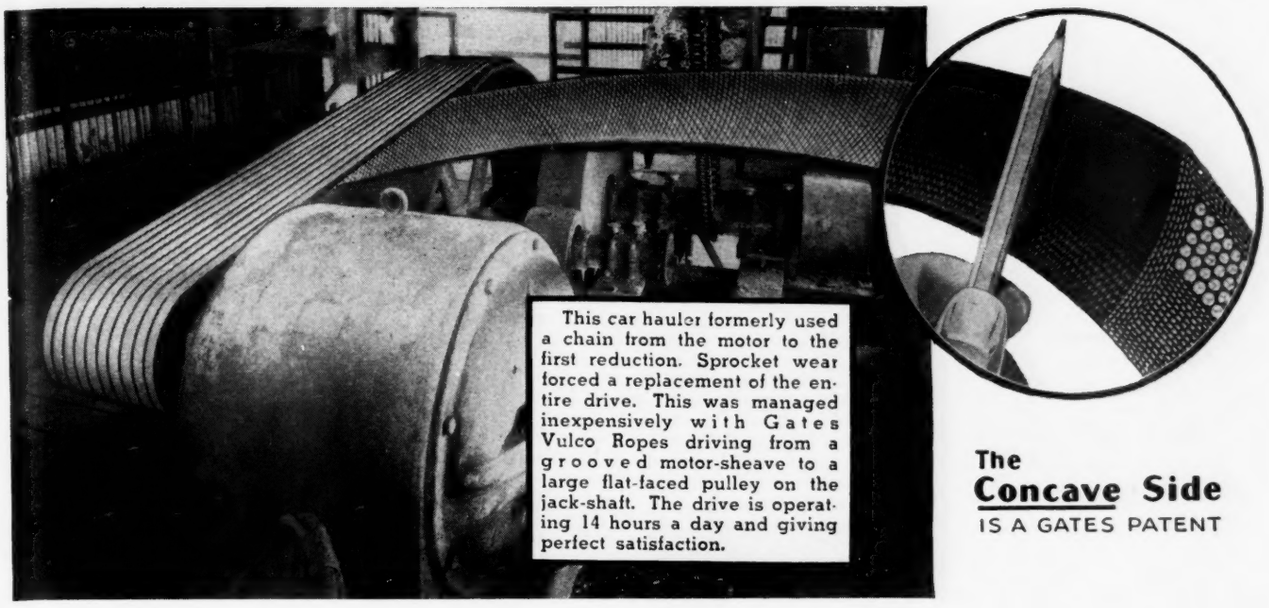
BITS RECONDITIONED BY SANDBLASTING

After three years' experimental work on exploratory core-drilling operations, Carboloy Co., Detroit, Mich., subsidiary of General Electric Co., has announced commercial availability of its "Sinta-Set" core bits, designed to reduce drilling costs, decrease drilling time, and eliminate the usual costly reconditioning and resetting of diamond bits.

In the new bits the entire matrix forming the crown of the bit is impregnated with industrial bort diamonds instead of following the usual practice of hand- or cast-setting individual diamonds in only the surface of the crown. The bits can be operated on any type of rotary drilling equipment actuated by steam, air, gas or electricity with either mechanical or hydraulic feed. Furthermore, the diamonds are considerably smaller and present in much greater number than in conventional core bits, insuring not only longer effective life per bit but also virtually completely eliminating all tendency to "track," with consequent failure to cut.

The question of diamond distribution through the matrix has been worked out in such a manner that the distribution compensates for the difference in cutting speed (surface feet per minute) between the outside and inside of the core bit—assuring equal wear over the crown and consequent increased life between reconditionings. The two primary methods used to accomplish this are: (1) control of the diamond distribution in the matrix itself, and (2) the use of



This car hauler formerly used a chain from the motor to the first reduction. Sprocket wear forced a replacement of the entire drive. This was managed inexpensively with Gates Vulco Ropes driving from a grooved motor-sheave to a large flat-faced pulley on the jack-shaft. The drive is operating 14 hours a day and giving perfect satisfaction.

The Concave Side
IS A GATES PATENT

In Two Minutes *This Test* Will Show You a big SAVING in V-Belts and Power

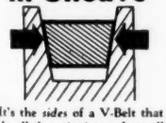
If you are interested in low operating costs, make this simple test:

Take *any* V-belt and have someone bend it as it bends in going around a pulley. (See photo above.) As the belt bends, grip its sidewalls between your finger and thumb. You will feel the belt's sides bulge outward.

This bulging gives a straight-sided belt the shape shown in figure 1, on the right . Clearly, this shape does not fit the sheave groove.

But when you bend a belt that is built with the patented Concave side, you find that the sides become perfectly straight—as shown in figure 2. Here are the advantages: This shape exactly fits the sheave groove; this means uniform sidewall wear—longer life! Also, the full side of the belt is gripping the pulley; therefore less slippage and this saves belts as well as power.

V-Belt in Sheave



It's the *sides* of a V-Belt that do all the *gripping* and get all the *wear*. That's why longer life for the *sides* means *longer life for the belt.*

The Gates Vulco Rope is the only V-belt built with the Patented concave side.

What Happens When a V-Belt Bends

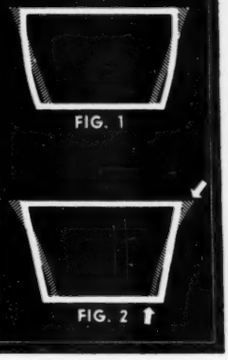


FIG. 1

FIG. 2

THE GATES RUBBER COMPANY

Engineering Offices and Stocks in All Large Industrial Centers

GATES VULCO ROPE DRIVES

CHICAGO, ILL., 1524 South Western Ave. HOBOKEN, N. J., Terminal Building BIRMINGHAM, ALA., 1631 1st Ave., S. LOS ANGELES, CAL., 2240 E. Wash. Blvd.

DENVER, COLO., 999 South Broadway DALLAS, TEX., 2213 Griffin Street PORTLAND, ORE., 333 N. W. 5th Ave. SAN FRANCISCO, CAL., 2700 16th St.

tapered segment inserts or tapered waterways.

The bits are produced by molding and sintering the matrix material in which the diamonds have previously been distributed. The ability to use molds for this purpose has a decided advantage in that it insures absolute maintenance of close tolerances on the finished bits. Use of a cemented carbide matrix for the bit has another striking advantage in that its greater hardness provides greater resistance to abrasion and therefore longer life. The matrix is so hard that in drilling highly abrasive materials wear is just sufficient to maintain proper cutting clearance. Thus wear of diamonds themselves virtually completely controls wear of the bits as a whole.

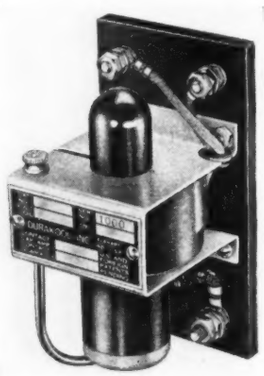
For sharpening the core bit, Carboloy, in cooperation with the Pangborn Co., Hagerstown, Md., has developed a simple, compact, low-cost universal sandblasting machine, composed of a blast cabinet, dust-exhauster motor and dust-collector bags. The unit is being marketed by Pangborn.

•

MERCURY RELAY

The Durakool mercury relay, offered by Durakool, Inc., Elkhart, Ind., utilizes the unbreakable metal body of the Durakool mercury switch and the displacement principle with solenoid actuation. The contact structure is hermetically sealed, making the unit especially suitable for use in corrosive or explosive atmospheres.

The relay may be operated up to 300 times per minute. According to the manufacturer, there is little friction and no wear in operation; the inherently rugged and simple construction eliminates risk of breakage in shipment or operation. The relay requires no maintenance or attention. No glass is used in its construction. The durable metal body is especially treated to hold a gas at a pressure of four atmospheres. Contact resistance is as low as 0.002 ohm. On a.c., as little as 1 watt is required for normal closing operation, and only 1.5 watts for normal opening operation. On d.c., the operating energy required is but 0.25 watt.



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SALT TABLET DISPENSER

A new salt tablet dispenser made of aluminum, specially plated, and called Dispens-Eze, is announced by the Milburn Co., Detroit, Mich. With a capacity of more than 1,000 10- or 15-grain tablets, the dispenser is impervious to attack from salt and is moistureproof.

In addition its mechanical simplicity, heavy construction and Yale lock (which both safeguards contents and locks it to the wall bracket) reduce the maintenance problem to a minimum and make it tamperproof.

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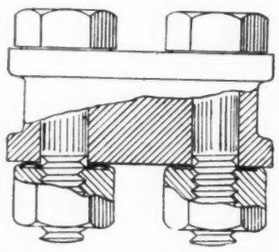
AUTOMATIC LOCK NUT

A new self-contained one-piece all-metal lock nut is offered by An-cor-lox Division of Laminated Shim Co., Inc., Glenbrook, Conn.



Known as the An-cor-lox lock nut, this new device utilizes a new locking principle that permits effective and positive locking of the nut to the bolt, not to the work.

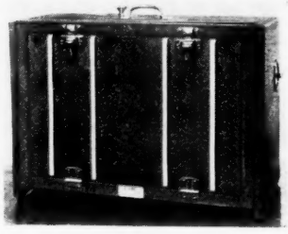
To apply, the lock nut is simply spun on the bolt and drawn up to the desired degree of tightness. The nut locks itself automatically to the bolt. The arcuate-shaped metal locking ring contained in the bottom of the nut is expanded by the locking pressure into the root of the bolt thread and against the nut rim. This "lock joint" is said to hold securely under all heat conditions and vibration. No special length of bolt is required.

•

PORTABLE PRINTER

A new Elpro portable printer is announced by the Ozalid Corporation, Johnson City, N. Y. This unit was designed to reproduce engineering drawings, letters, reports, maps; in fact, any pencil or ink lines, typewritten or printed matter appearing on one side of a reasonably translucent sheet.

The light source consists of six specially developed lamps. The case is finished in attractive gunmetal and a highly polished aluminum reflector assures uniform distribution over the printing surface. A new feature is a dry developing chamber which is conveniently located behind the metal reflector, thus utilizing the heat generated by the lights to vaporize the developing agent. An additional feature is a time switch which allows the operator to regulate automatically the period of exposure.



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AUTOMATIC LUBRICATOR

Continuous feeding of lubricant to its bearing, regardless of viscosity or temperature changes, is claimed for the automatic lubricator being marketed by the Simplex Mfg. Co., Detroit, Mich. It is intended for replacement of grease fittings or oil cups upon vehicles and machinery of all kinds as well as for original equipment. One size, ¾ oz. capacity, is now available, but larger sizes are under development.

The lubricator is essentially a spherical steel shell with a grease fitting and ¼-in. pipe thread connection for insertion in the bearing hole or a suitable adaptor, of which several patterns are available. Inside the steel shell there are a hollow neoprene (grease-resistant rubber) ball and an outlet channel that prevents the ball from clogging the outlet. The expanding

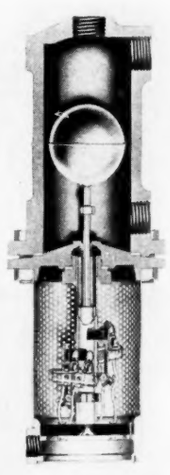
ball constantly presses lubricant into the outlet, whence it is picked up by wiping action of the bearing surfaces only when the bearing is in action.

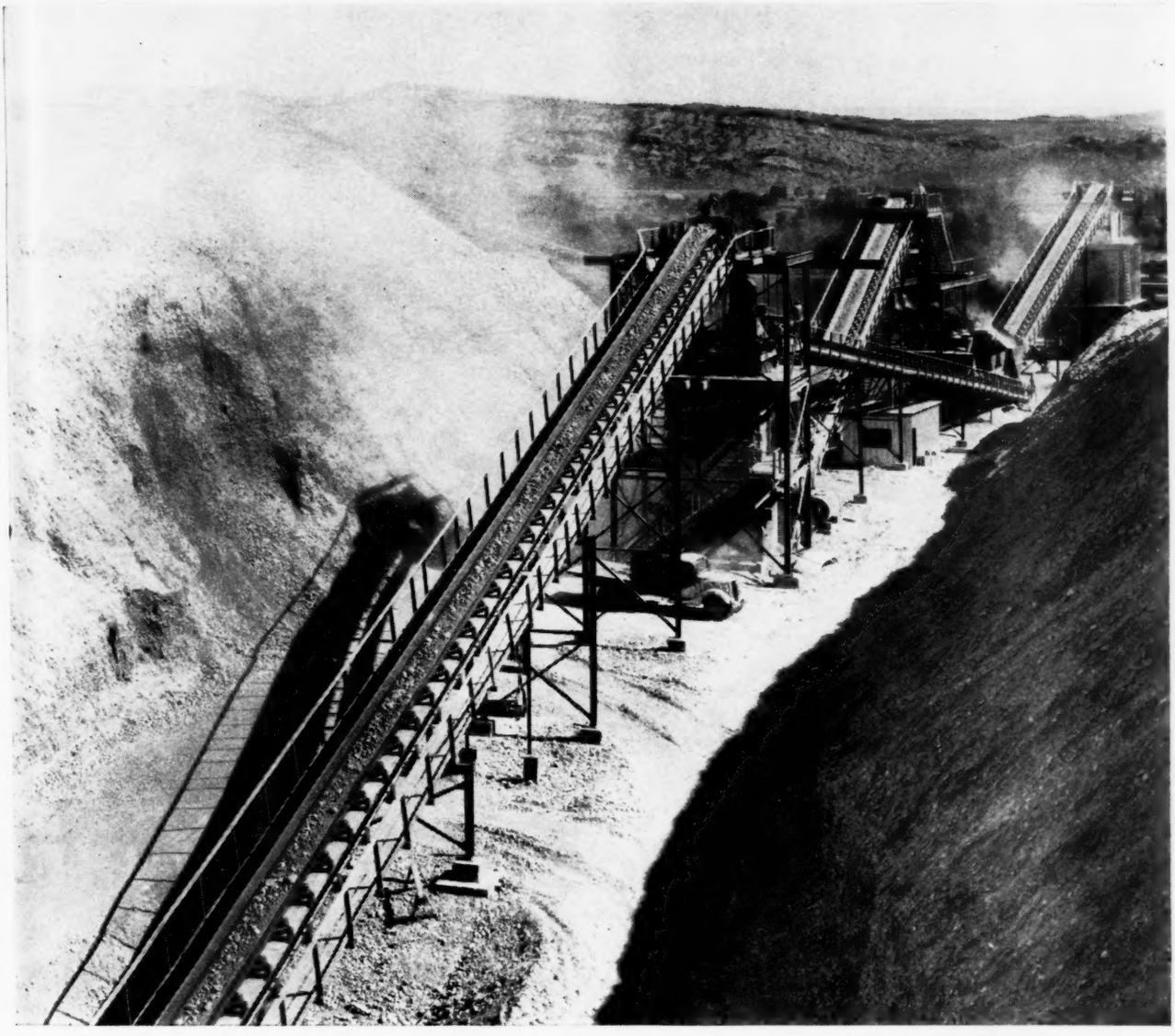
•

LIQUID LEVEL CONTROL

Fred H. Schaub Engineering Co., Chicago, offers a new liquid level control, the Magnetrol, employing the simplest principle of operation to gain a desired switching action in float-type units. This switching action is obtained through the rise and fall of a piston attached to a float rod moving up and down in an inclosing tube. As the piston reaches a predetermined level in the tube, it comes into a magnetic field produced by a permanent magnet located on the outside of the inclosing tube. When this occurs, the magnet is drawn toward the piston, causing a tilt action of a mercury-to-mercury switch which is a part of the magnet relay arm.

The Magnetrol is unaffected by temperature or operating pressures. As standard equipment it comes in two separate models. One model has a single switching action which may be used as a low water cutoff on a steam boiler or to operate a pump or an energized valve in connection with a tank or other liquid level application. The other model incorporates three stages of liquid level control for use as a low-water cutoff, pump control, and high-water cutoff on boilers or for stage control on other liquid level applications. An alarm circuit also may be incorporated in either model.





The rubber roller coaster that takes mountains for a ride

A typical example of Goodrich development in rubber

TAKE a look at plants that furnish stone for roads, dams, bridges. Whole mountains of gravel are carried by rubber-and-cotton conveyor belts to crushers and screens, where rocks are crushed and sorted according to size.

Looks troubleproof, but big rocks would catch in pulleys, tear expensive belts to ribbons.

Goodrich engineers weren't going to let that go on . . . they developed an entirely new belt design. Instead of stiff woven fabric which cuts and tears like any cloth, this new Goodrich belt is made of individual cords like a tire, some lengthwise, some crosswise, each cord surrounded with rubber. Tearing action won't pass along the belt—at worst an obstruction causes a small, easily-repaired hole instead of a long, ruinous tear.

The new Goodrich belt was installed in the Wyoming plant in the picture. A test (not on the program) came the first day. A heavy crowbar caught in the belt, bent like a hairpin around the pulleys, and wedged against the framework where it would have ripped any other belt to useless shreds. But the Goodrich cords held until power could be shut off, and a $2000 belt was saved.

Goodrich improvements in all rubber and synthetic goods are making savings just as spectacular, in plants in every industry. Isn't it just good business to let your Goodrich Distributor tell you what those savings might be in your operation? *The B. F. Goodrich Company, Mechanical Goods Division, Akron, Ohio.*

Goodrich

ALL *products problems* IN RUBBER

(Another story of Goodrich development work appears on page 83)

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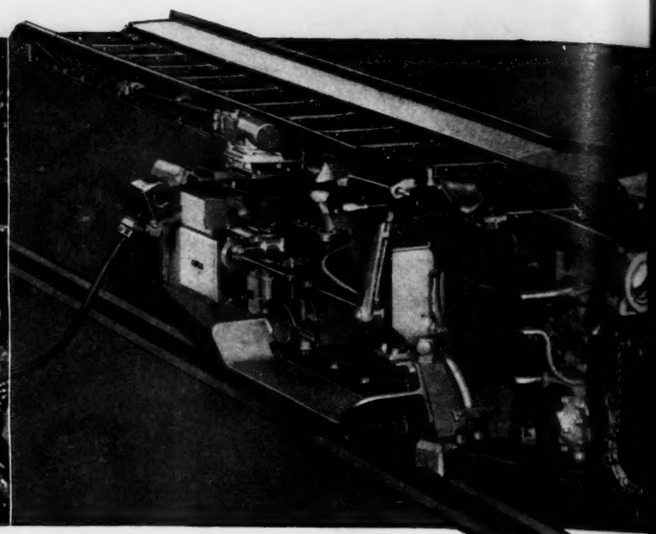

Production at the Face.. *Tonnage* at the Tipple.. with Goodman

GOODMAN BUILDS A COMPLETE LINE OF TRACK MOUNTED CUTTING MACHINES

Complete information will be furnished upon request.

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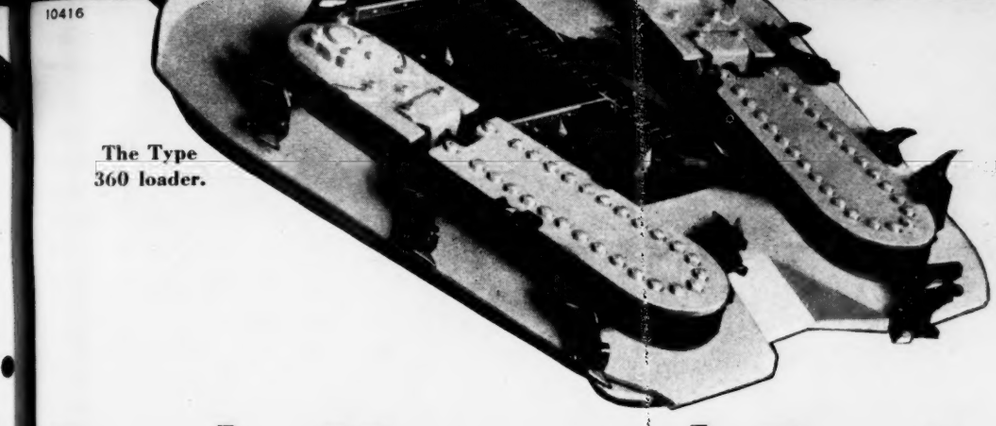


10416

The Type 360 loader.

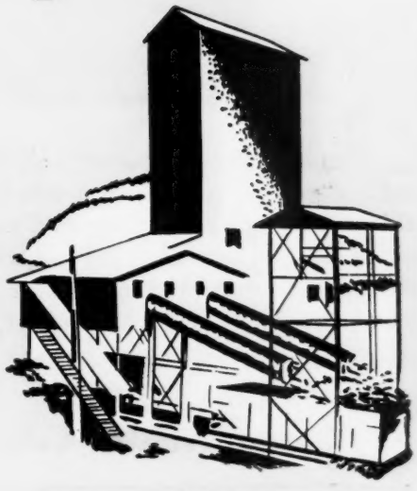
The GOODMAN TRACK TYPE LOADER

MAY HAVE EITHER MECHANICAL OR HYDRAULIC CONTROLS. IT IS SUITABLE FOR BOTH LOW AND HIGH SEAMS AND WILL LOAD COAL, SLATE AND ROCK.

Track Mounted Equipment

Mechanized cutting and loading, with Goodman track mounted equipment on the job, has preserved the profit margin for many mines. These powerful, speedy and easily controlled track type machines have a wide range of application.

The co-ordination and high productive capacity of Goodman track cutters and loaders in such a system reduce operating delays to a minimum, and consistently accelerate production to new and profitable tonnage records.

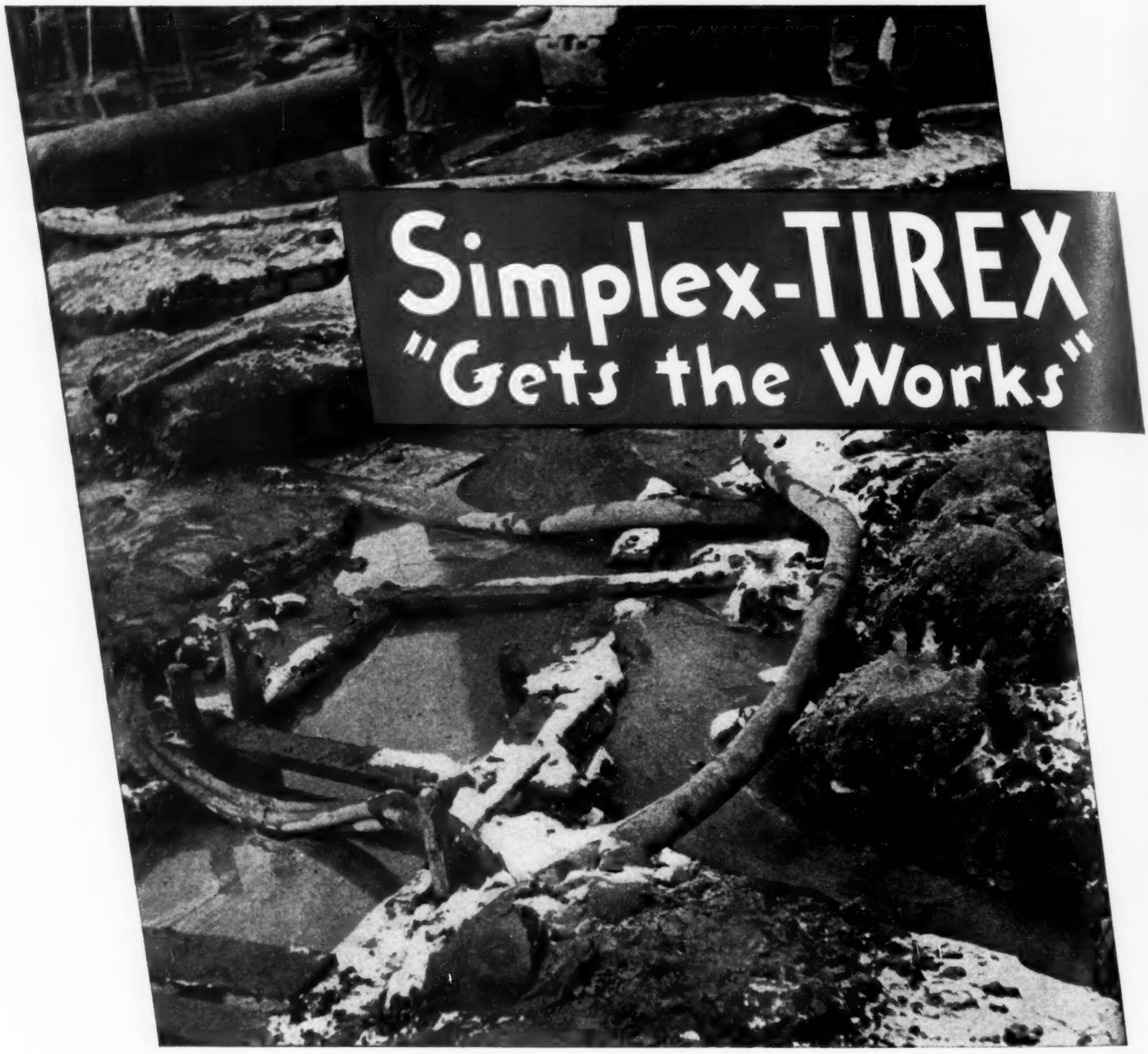


Write for illustrated bulletins.

Goodman

MANUFACTURING COMPANY

HALSTED STREET AT 48TH, CHICAGO, ILLINOIS



Simplex-TIREX rubber sheathed portable cables "get the works" on a construction job like this. They carry on in spite of water, mud, run-overs, ice, etc., because of the protection offered by their selenium cured, tough rubber armor. This rubber armor is the toughest, most abrasion resistant, flexible cable covering available.

When you have a difficult problem for portable power cables — select the cable for the job. Don't use any old cable you have in stock. Get cable that fits the work.

We stand ready at all times to consult with you in an effort to supply you with the kind of a power cable you want.

Simplex Wire & Cable Company, 79 Sidney Street, Cambridge, Mass.

Simplex-TIREX
The only cable armored with Selenium Rubber